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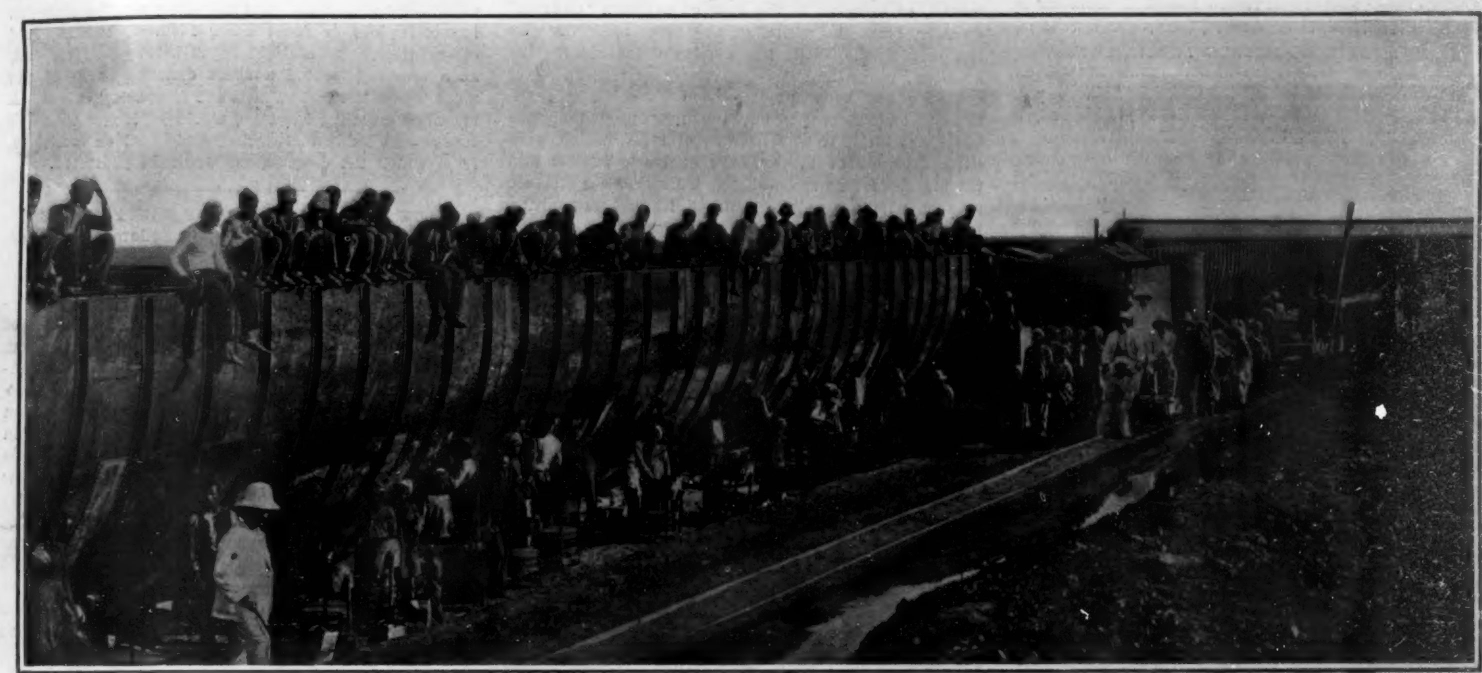
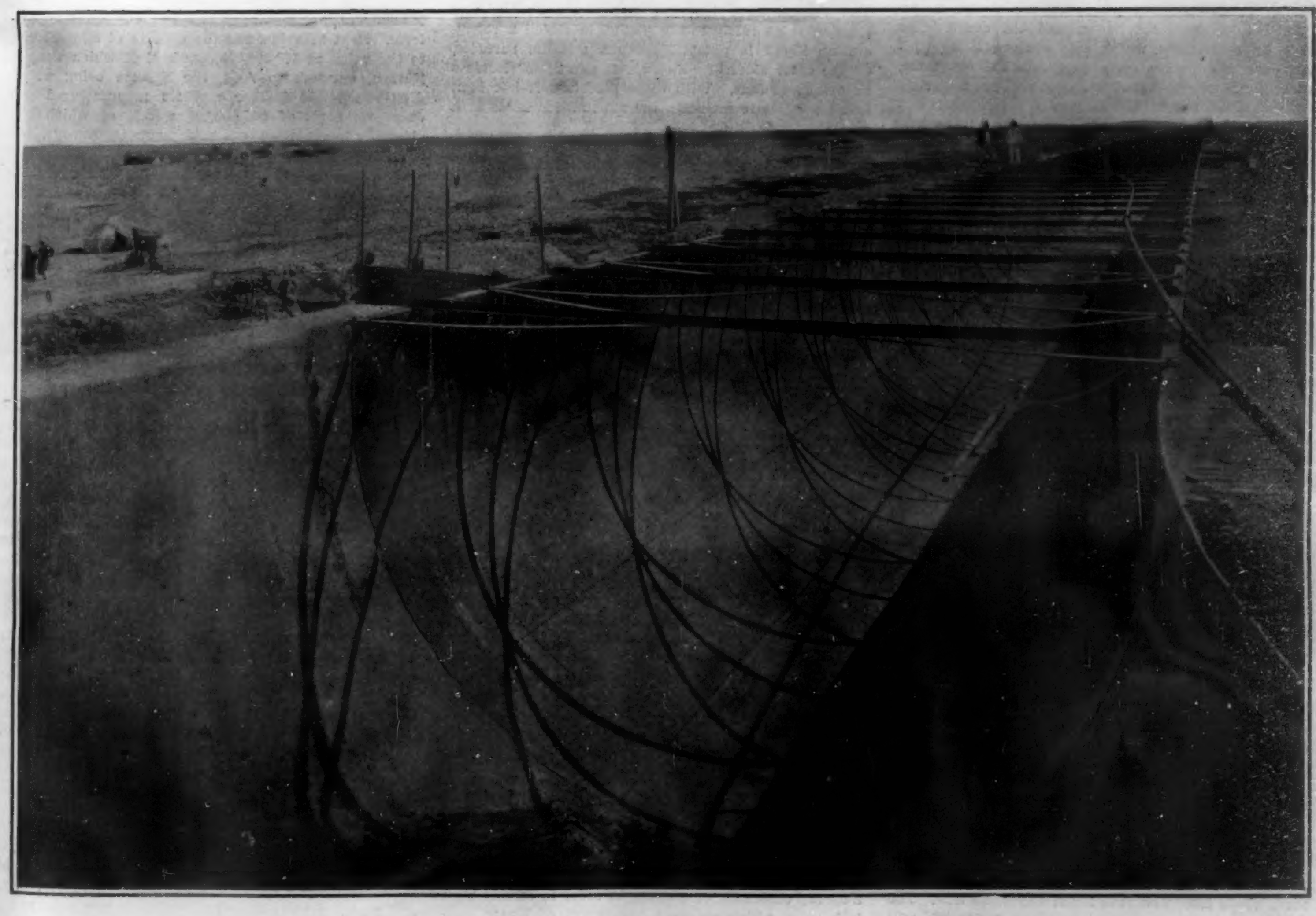


A Section of the Canal, Ready to be Jacked Into Position Before Being Packed with Its Earth Support.



An Interior Section of the Canal.

A NEW EGYPTIAN IRRIGATING CANAL.—[See page 122.]

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NEW YORK, SATURDAY, AUGUST 17, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

CONCRETE AND CUPIDITY.

The recent fatal collapse of the Bridgman Building in Philadelphia, which took place while it was yet under construction, sounds another warning as to the great perils attaching to careless construction of armored concrete buildings, and the growing necessity for the very strictest supervision of such work. Never has the engineer developed a more useful material of construction than when he devised that ingenious and thoroughly scientific combination known as armored or reinforced concrete. On the other hand, never did he open up to the eyes of the unscrupulous and "shoddy" builder such prospects of unlawfully but quickly acquired gain. Intelligently designed, carefully compounded, and put together with due deliberation and proper time allowances for setting and bonding, armored concrete is one of the cheapest and most reliable forms of building construction the world has ever known. But whenever the design is intrusted to incompetent hands, and the construction done by contractors whose sole concern is to rush the work and secure early payments for the same, armored concrete is one of the most perilous materials that could be imagined. Already the ignorance and cupidity which are rampant have succeeded in putting armored concrete under a heavy cloud of distrust, from which it will take many a long year to recover. If the public is not to lose entire confidence, some speedy reform or drastic preventive legislation must be quickly introduced. The design of reinforced concrete, at least in the case of the more important structures, should be restricted to engineers and architects who are familiar with this branch of the arts, which should be safeguarded by laws drawn up for its special protection.

AMBROSE CHANNEL NOW ONE-HALF COMPLETED.

When the new Cunard liner "Lusitania" reaches Sandy Hook lightship, she will be able to enter New York harbor through a channel 1,000 feet in width, 40 feet deep, and 7 miles in length, cut through the outer bar, and extending from deep-sea soundings to the Narrows. This waterway represents the first half of the great Ambrose channel, which the government is excavating with a view to improving the entrance to New York harbor. If the forecast of the army engineers be correct, in about four years from the present time this great work will be fully completed, and it will be possible for the whole of the maritime traffic to and from the port of New York to steam directly to the Narrows through a channel 2,000 feet in width, which will afford a uniform depth, even at low water, of 40 feet. The full-load draft of the largest ships afloat, the "Lusitania" and "Mauretania," is 37½ feet, and as they will rarely, if ever, draw this much, it is reasonable to suppose that the Ambrose channel will be ample for the needs of navigation, at least for the coming two decades.

Outside of engineering circles the magnitude of this undertaking is but little appreciated. When work was commenced on the contract in 1901, there was a minimum depth of 16 feet of water along the route of the channel. Since that time the suction dredges have removed 26,000,000 cubic yards of sand, gravel, and mud, whose total weight is about 40,000,000 tons. The work, which has cost to date about $2,500,000, will have cost by the time it is completed fully $4,000,000. The two large dredges now engaged on the work cost $400,000 each, and the government proposes to build two more of equal, if not greater, capacity. For the present, the 1,000-foot channel will be restricted to the use of ships drawing 29 feet and over, this arrangement being necessary in order to limit the number of vessels using the new waterway while the dredges are completing the unfinished half of the channel.

SMOKELESS POWDER AND AMMUNITION ROOMS.

The many fatal accidents which have occurred during the past few months on naval vessels, chief among which was the disastrous explosion on the French battleship "Jena," have been traceable, directly or indirectly, to smokeless powder. In many cases the accidents have been due to deterioration of the powder, and in all cases they have resulted from the greater risks which attend either the storage of the powder or its manipulation from the handling room to the breech, or even, as in the case of our own "Georgia" disaster, from the action of the gases after the gun has been fired. While the wonderful increase in the accuracy, range, and striking energy of modern naval ordnance has been due to the high ballistic qualities of smokeless powder, the new propellant has brought with it a whole series of risks, which were little dreamed of in the days of black powder and the muzzle-loading smoothbore. These risks commence as soon as the powder is stowed in the ammunition holds; for not only are modern powders more sensitive to heat than those which they displaced, but the conditions which tend to raise the temperature in the ammunition rooms have multiplied very materially in the modern warship. The sensitiveness to temperature and the tendency to chemical decomposition, both elements of danger, are difficult to remedy; since, as far as our present knowledge goes, they are inherent qualities of the high explosives, or combinations of high explosives, which give to modern smokeless powder its wonderful qualities. On the other hand, the risk from overheating of the ammunition rooms is entirely removable; and the French naval authorities, stimulated by the "Jena" disaster, are giving particular attention to this question. It is realized that arrangements for cooling which are entirely satisfactory for holds intended for carrying perishable provisions, are quite inadequate for ammunition storage. The holds of provision ships are not opened during the whole trip; but ammunition holds have to be constantly opened, in accordance with the requirements of a naval cruise. Consequently, simple cooling by ventilation is not sufficient, and the best modern practice recognizes the necessity for refrigerating the air before it is forced into the hold. The French have installed on several French and Russian ships refrigerating plants, in which a refrigerating liquid is pumped between metallic surfaces, on the outer sides of which air is caused to circulate by means of fans. With these machines it has been found possible to maintain the ammunition holds at a constant temperature.

The problem of the powder is more difficult, since it is not solvable by any mere mechanical system. We have not been so much troubled with chemical decomposition as have some of the European nations, and this for the reason that, many years ago, we adopted, in the navy, an all-nitro-cellulose powder, and, in the army, a powder containing only twenty-five per cent of nitro-glycerine. Because of its great energy in proportion to its bulk, European manufacturers have used nitro-glycerine in large proportions, the earlier English cordite being composed of about sixty per cent of this explosive; but they have naturally experienced much difficulty in producing powders that would remain stable for any reasonable length of time. Of late years they have been coming more to the proportions adopted in this country, the present modified cordite having only about thirty-five per cent of nitroglycerine in its composition. However, even in this country we are experiencing trouble with variation of powder pressure, and this, of course, produces irregularity in the velocity, and therefore in the accuracy of the gun. There is still a demand for a powder that will combine with high ballistic qualities absolute stability in storage and unvarying pressure in the powder chamber.

ROUTE OF CATSKILL AQUEDUCT CHANGED.

As one result of the present extensive surveys, it is probable that an important change will be made in the route of the Catskill aqueduct on that section which extends from the Ashokan reservoir to the easterly shore of the Hudson River. The new route will leave the reservoir at a point near the site of the Olive Bridge dam and further toward the western end of the reservoir. It will extend in a southerly direction, several miles to the westward of the original location, intercepting the Hudson River just above Storm King Mountain. The first location was laid down under the pressure of the necessity of making a speedy choice of some route, in order to comply with legislation which required the Board of Water Supply to file plans with the State Water Supply Commission and secure its approval, before proceeding with the preliminary work. Subsequent surveys have developed the fact that there is no suitable rock for a deep-level tunnel beneath the Hudson River at the proposed crossing. Borings which have been made at various points up and down the river, point to the probability of obtaining unfissured rock in the neighborhood of the Storm King Mountain. Shafts are now being sunk on each side of the river to a depth of about 600 feet below the water surface, and 400 feet below the level at which the aqueduct tunnel reaches the river face of the mountain. When the shafts have reached the desired depth, horizontal test tunnels will be driven across from shaft to shaft—a distance of 2,000 feet—to determine whether the rock is of sufficient solidity and freedom from fissure, to withstand the enormous water pressure of 33 tons to the square foot, which would be exerted against the walls of the tunnel at this depth. If the test tunnel shows the rock to be unsuitable, it is likely that the water will be conveyed in steel pipes or some other form of conduit, laid either upon or at a slight depth below the river bed, at a crossing located a short distance north of the point where the test tunnels are now being driven. A river-bed crossing, however, would be longer than the tunnel and liable to injuries, accidental or malicious, from which the deep tunnel would be protected.

GROWTH OF OUR EXPORTS OF MANUFACTURES.

Over three-quarters of a billion dollars of manufactures passed out of the ports of the United States in the fiscal year which has just ended; and of this enormous total $740,000,000 was sent to foreign countries. A gratifying feature of this trade is the fact that two-thirds of it was shipped in finished form, ready for consumption, and one-third of it in partially manufactured form for further use in manufacturing. Exports of finished manufactures show an increase of about $20,000,000 over last year, and an increase of $267,000,000 over the year 1897; while manufactures for further use in manufacturing show an increase of $34,000,000 over last year, with an increase of $162,000,000 during the past decade. The distribution of this $740,000,000 of manufactures sent abroad last year is instructive. One hundred and eighty-one millions represented the value of iron and steel manufactures, an increase of $20,000,000 over last year, and of this total amount about 85 per cent was shipped in finished form ready for consumption. Exports of manufactures of copper represented $89,000,000, of which $85,000,000 went to Europe. The next largest item was that of manufactures of wood, whose value amounted to $80,000,000, of which $55,000,000 worth was shipped in a partially manufactured form. Next in value was the exports of mineral oils, to the value of $78,000,000, one-half of which went to Europe, one-fifth to Asia, the balance being widely distributed. Of leather and its manufactured products we exported $45,000,000 worth, of which considerably more than one-half went to Europe. Of cotton goods we exported $32,000,000 worth; and agricultural implements represented a value of $27,000,000. Summing up on a basis of distribution, we find that $350,000,000 worth went to Europe; $200,000,000 to North America; $100,000,000 to Asia and Oceania; $75,000,000 to South America; $15,000,000 to Africa; and the remaining balance of $40,000,000 to non-contiguous territories.

A PRIZE FOR THE EXTRACTION OF FLAX.

The New Zealand government has offered a prize of $25,000 for an economical process for the extraction of flax from the native plant, either by chemical or mechanical agency. This plant, which is cultivated in many climates similar to that of New Zealand for its beautiful flower, is entirely distinct from the ordinary plant from which flax is procured. The leaves, which are from one to three inches in width at their broadest part and from two to six feet in length, are of a fibrous nature, and it is from these and not the stalk that the flax is obtained. Bleaching this fiber, however, is a difficult process, owing to the large amount of viscous, resinous, and gummy substances impregnated therewith, and which cannot easily be removed. Consequently, the resultant fiber is only used for the coarser materials, such as sail cloth, where a pure whiteness is not particularly required. The process generally adopted for the extraction of the fiber from the leaves is maceration, but the most efficient and satisfactory, though essentially primitive and slow, is the method practised since time immemorial by the natives. By a deft movement of their thumb nails they remove the thin outer skin from the leaf, and then comb out the fibers with small combs, no macerating process of any description being resorted to. The product thus obtained is of excellent quality, possessing a silky luster and of great strength and durability, and is mostly employed for the manufacture of rope, twine, and mats.

The plant grows very luxuriantly and prolifically, and will thrive in the poorest soils, being found very extensively in a wild state all over the country. When cultivated, three harvests of leaves can be procured

every year from each plant, and about twelve tons of leaves can be cut from each acre of cultivation. It is stated, however, that if more scientific methods of cultivation were practised, the yield per plant per acre could easily be doubled. There are already over four hundred mills in operation devoted to the treatment of this flax, the exports from the country averaging over $4,000,000 per annum; and although the product is stronger and more durable than that usually employed, and is in great demand for certain classes of goods, once the degumming problem is satisfactorily surmounted, permitting the flax to be bleached readily and easily, it will constitute a formidable rival to the European and Asiatic fiber, more especially in view of the fact that it is considerably cheaper and stronger than the latter varieties. The government anticipates that by the announcement of the above award greater attention will be attracted to the problem, and a cheap and efficient process for production evolved.

A COLLEGE OF INVENTION.

BY GEORGE FREDERICK STRATTON.

Generally speaking, inventors do not make a business of inventing, but very frequently chance upon ideas which are entirely unconnected with their usual occupations, and which they seize and develop into more or less practical results. What the mental processes are that so frequently turn men from the matters with which they come daily face to face, impelling them to consider entirely foreign problems, is hardly explainable. Fulton, of steamboat fame, was a portrait painter; Morse, the inventor of the telegraph system, was an artist; Whitney, of the cotton gin, was a law student; Arkwright, who invented the spinning jenny, was a barber. Of the group who developed the steam engine, Watt was a mathematical instrument maker, Newcomen a blacksmith, and Smeaton a civil engineer. The list showing similar incongruities could be extended until it embraced a very great majority of all the inventors to whom patents have been granted. But a change has come in the methods by which patentable ideas are taken up and developed. Inventing has grown into a systematized business in which hundreds of men are now actively and steadily engaged; a very large proportion of them under salary from the great industrial corporations.

Highly-trained scientists are rarely inventors. They are rather investigators and discoverers, going deeply into causes and effects; searching for new elements and elemental forces, and determining with mathematical accuracy the scope and extent of such forces. Long before Stephenson the theories of steam—of heat, combustion, and condensation—were ably discussed and philosophically explained, but it remained for the mine laborer to put those theories to practical application in the locomotive.

It must by no means be inferred that the work of eminent scientists and philosophers is lightly thought of. To their great discoveries is due the opportunity of the inventor who follows them, and who, taking advantage of the things they have discovered, devises the means of applying them to practical uses. In short, the great intellects trained to analytical deduction and mathematical exactness concern themselves with theories, principles, research and conditions, leaving the practical results by means of mechanical devices to men less gifted in the qualities they possess, but usually far more greatly endowed with ingenuity and commercial enterprise.

It is the latter class of men for whom industrial managers are eagerly looking, and although inventors are always plentiful, as shown by the records of the Patent Office, they seem to be but seldom available for salaried positions. A firm engaged in the manufacture of textile machinery, and desirous of securing two or three men of mechanical ingenuity, searched the patent records of the preceding year, from which twenty inventors were selected. The list was not confined to improvers of appliances for manufacturing wool and silk, but included those whose patents showed unusual ingenuity in the invention of intricately delicate mechanical devices in any line of industry. Although out of the entire number only one had pushed his invention to a commercial success, from the others the firm succeeded in engaging but one man. The rest were in occupations which they could not be induced to leave. Some were in the professions; the others were small business men, clerks, or mechanics. It was found that although most of them would have been very willing to accept a salary, they were by no means confident of continued ability. Each had invented some remarkably ingenious article, sometimes several, but the idea of engaging in inventing as a permanent occupation—of feeling compelled to focus their ability or genius upon some one definite problem —was so new that it was staggering.

The manager of a great company, which has on its engineering staff nearly one hundred men who might be termed inventors, was recently asked: "Where do you obtain such men?" He replied: "It is not easy to answer. The chief men—the engineers—usually come from the colleges, as do also some of the assistants. But the bulk, upon whom we depend for all the little improvements and changes which are constantly required, come from all over. Some are mechanics; there is a doctor, a tailor, a conductor, and an agent. Most of these were secured when they came with inventions of their own, made when following regular occupations. Usually they turn out well. But we can't always hold them long, and there is trouble to replace them. I wish there was a training school for inventors!"

And why not?

In every other line of endeavor there are organized methods of education and training. For art, literature, law, medicine, and religion we have the great universities and colleges. For technical professions we have technical schools. We have manual training schools and apprentice systems for mechanics. But nowhere is there provision for training, guiding, and developing the very peculiar line of genius known as invention.

To many it may appear that educational opportunity for such men is already afforded by the institutions above noted; but all of them fall far short of the actual requirements for the best and most lucid development of practical inventive ability. Whatever the future holds for the business of inventing, it is to the past we must now look for guidance in determining the men to be helped and the methods of helping them. And that past shows, undeniably, that the most notable and ingenious inventors have not been men to whom abstruse and mathematical studies are familiar.

If we eliminate the universities and technical colleges from consideration as the best training fields for inventive natures, there remain the manual training schools and apprentice systems. And again what do we find? That the inventors of the past and the inventors of to-day have very seldom given their inventive attention to matters actually connected with their regular trade or occupation.

Many peculiarities are found continually in the study of inventors and inventions, and if they show anything, they show indisputably that the inventor is a free lance. The selective system of study or training in colleges, technical schools, and trades is not for the true inventor. Given a young man who has shown undoubted mechanical ingenuity, and keeping the past in mind, his training, commencing after his graduation from grammar school, should consist of the largest scope and opportunity for observing what has been done by others, rather than confinement to routine study. Mechanical drawing he should learn, but only sufficient to enable him to put his own ideas clearly upon paper and to read other drawings. If he is to become a professional inventor, he will not want to waste his time competing with skilled draftsmen. Models and drawings, and lectures thereupon, of every known description of mechanical movements should be provided, and every opportunity given for long and secluded study of the same. The drilling on this branch could not be too comprehensive or thorough. The calculation of the strength of beams and trusses, of the friction of the flow of liquids in pipes, would be wasted time. They are problems for the man of fixed theories and mathematical exactness—not for the imaginative inventor. A comprehensive study of patent laws and their application, and a familiarity with the method of searching for conflicting inventions, would be highly desirable. Lectures should be given upon the commercial view of inventing, so that the young man may gain some insight into the methods of estimating the values of the problems he may be tempted to fix his mind upon. These lectures should also bear upon the formation and practice of stock companies and the adjustment and payment of royalties. The great purpose should be to impress upon the student the wisdom of always putting his efforts upon things which will pay; for in mechanical appliances it is really only those things which pay that are of real benefit. Easy access to manufactories of the greatest possible diversity would be one of the most essential requirements. Such practical demonstrations of machines and tools should be considered a part of the college course, and be made one of the greatest sources of information.

Ample time and opportunity should be afforded for comprehensive study of trade magazines in every line of industry, for it is here more than in any other literature that the requirements of industry are revealed. Specializing of study would seem, in the light of the past, to be wasted time. You may keep a man's attention centered for months or even years on steam-engine construction, and if he is a true inventor he is likely, at any moment, to switch off to a labor-saving device in the shoe-making industry. His education and training should be confined to whatever will enable him to see and appreciate clearly difficulties in any existing apparatus in any line of manufacture, and should give him the confidence and patience to tackle that difficulty and eliminate it. Mechanical deftness is not an absolute necessity, although every opportunity should be afforded to qualify men in the use of tools and the making of their own models.

But above all, the greatest utility of a college of invention would be in its repression of the feverish impulse most inventors have to solve each and every problem presenting itself, merely for the sake of solving it; and in its guidance toward commercial success.

SCIENCE NOTES.

Mr. C. W. Whymper has just brought to notice a curious point with regard to the position of the ear in the woodcock. The snipe, it may be remembered, are remarkable for the fact that the external ear is placed *under*, instead of *behind*, the eye, as in other birds; but in the woodcock it is placed in *front* of the eye, and more so on one side of the head than on the other. This asymmetry, furthermore, extends to the shape of the aperture, which is slightly different on the two sides of the head.

A method of preserving meat has been brought out in France by H. De Lapparent which seems to have met with considerable success. It can be also applied on a small scale for household purposes. The principle consists in exposing the meat to sulphurous acid fumes. By burning a small amount of sulphur in a receptacle containing the meat hung up in place, it can be preserved for several days, even in summer. There is no taste left from the sulphur fumes and there seems to be no danger to health. Such a method can be used also on a large scale for preserving meat for army use, as it is quite simple and easy to apply in practice. From experiments made on a large scale it appears that the meat fumigated with sulphur did not contain more than 22 grammes (340 grains) of sulphurous acid gas per 100 kilogrammes (220 pounds) of meat, which is on the order of ten thousandths. The meat should be fumigated as soon as possible after killing and preferably on parts which have no cut bones. Lean meat is found to keep best. To preserve it for several months, meat can be inclosed in vessels full of carbonic acid gas. It has the appearance of fresh meat and its taste is not changed after cooking. In England, Mr. Lascelles Scott proposed a method which consists in immersing the meat in a solution of bisulphite of lime.

The possibilities of certain grasses being utilized for the purpose of fertilizing, and thereby reclaiming for cultivation, waste stretches such as sand dunes, has been strikingly demonstrated upon King Island, which is situated between the coasts of Tasmania and the Australian mainland. This island has always been an arid waste of sand and other non-arable soil. Some few years ago however a vessel was wrecked off the island, and when broken up under the force of the waves a number of the sailors' mattresses, which were stuffed with the yellow-flowered clover, a kind of grass, were washed ashore. A certain quantity of seed was contained among the stuffing, and in due course these took root, and owing to their prolific growth, in the space of a few years covered the sandy stretches with rich verdure. It is a long-established fact that clover and other leguminous plants have the peculiar capacity of fertilizing a waste soil, owing principally to the action of bacteria, thereby enabling the plants to draw nitrogen directly from the atmosphere. In the case of King Island, owing to the properties of this yellow-flowered clover, what was previously a waste stretch of sand is now one of the richest grazing districts in the Australian continent. The growth of the plant completely changes the character and color of the soil from a dirty white to a rich dark brown or black loamy nature.

THE CURRENT SUPPLEMENT.

From time to time during the past two or three years there have been references to Maguay fiber in the public press, and now small quantities are finding a market in this country. Charles Richards Dodge, in the current Supplement, No. 1650, presents a careful *résumé* of his investigation of the varieties of the Maguay fibers, and accompanies his text with many interesting illustrations. A torpedo guided by aerial electrical waves is described. Augustus B. Tripp gives an account of a wireless telegraph apparatus for lecture purposes. There are but few problems in the design of ships, as in most branches of engineering, that can be exactly or completely solved, in the full scientific meaning of the word, and those are of a secondary character. These important problems are considered by Francis Elgar in an excellent paper entitled "Unsolved Problems in the Design and Propulsion of Ships." Lieut. Schackleton's expedition to the Antarctic is described and his equipment illustrated. "The Seed, a Chapter in Evolution," is the title of a paper by Prof. F. W. Oliver which may be considered a trustworthy review of recent knowledge. The paper is concluded from the last Supplement. James Asher presents some rough and ready methods of estimating heights and distances. Clocks, Ancient and Modern, are described by W. S. Eichelberger.

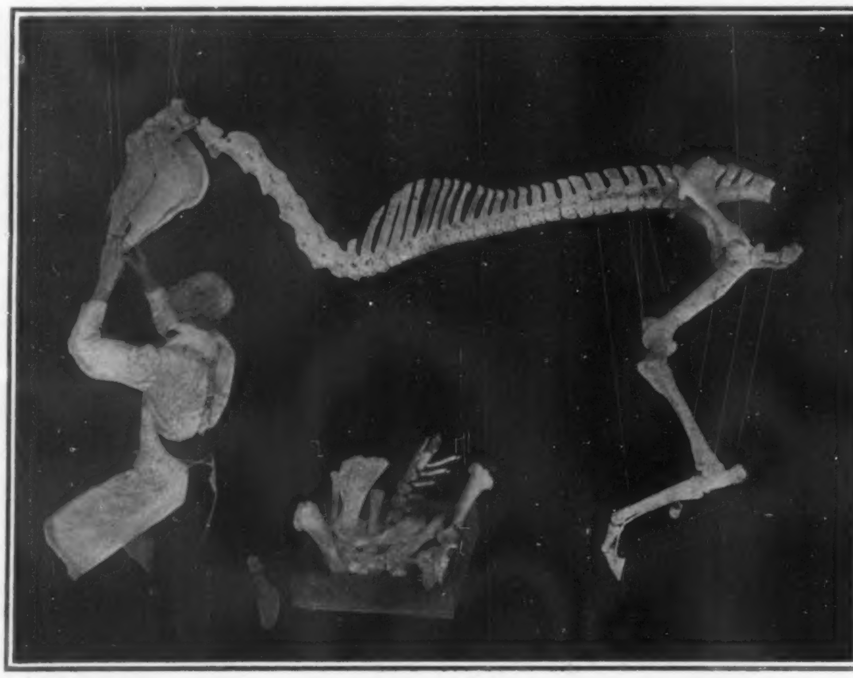
A SCIENTIFIC STUDY OF THE RACEHORSE, AND ITS USE IN MOUNTING THE SKELETON OF SYSONBY.

Sysonby is the name of one of the greatest racehorses. His skeleton is to be mounted in running position in the American Museum of Natural History. To further that purpose, a series of new and very remarkable instantaneous photographs will be used in furnishing important and accurate details for the final mounting of this great runner. Mr. James R. Keene, his owner, presented the skeleton, as well as the sum of $2,000 for the purpose of preparing it for exhibition. Aside from his long list of money victories, amounting to $200,000, one of the largest sums ever won by a racehorse in the United States, Sysonby is of scientific interest because his skeleton typifies, more than any other turf champion, the highest and speediest type of the American thoroughbred horse.

Prof. Henry F. Osborn, Curator of the Paleontological Department of the Museum, the most brilliant historian and explorer of the horse in America, is directing the scheme of presentation, and Mr. S. H. Chubb, a well-known expert on the Museum's staff, has been entrusted entirely with the difficult and intricate task of mounting Sysonby's skeleton. Mr. Chubb is recognized as the highest authority in this particular line of work. Prof. Osborn has decided to mount Sysonby in the most original and realistic manner, just as the animal was winning one of his principal races, something never attempted before.

Sysonby's death, at the early age of four years, occurred at the Sheepshead Bay track on June 17, 1906, after an illness of three months, due to a mysterious and baffling malady, diagnosed as septic poisoning. The combined skill of four veterinarians, a physician, and a skin specialist composed the medical staff which fought hard to save the life of their noted turf patient. An autopsy showed that the heart and lungs were of usual proportions. The liver furnished the greatest surprise, since it was three or four times larger than the normal size. Sysonby was buried in a plot in the training quarters at Sheepshead Bay. One month later, during which interval Mr. Keene was undecided as to the final disposition of the remains, he concluded to present the skeleton for permanent mounting in the Museum, together with the fund named for carrying out this purpose.

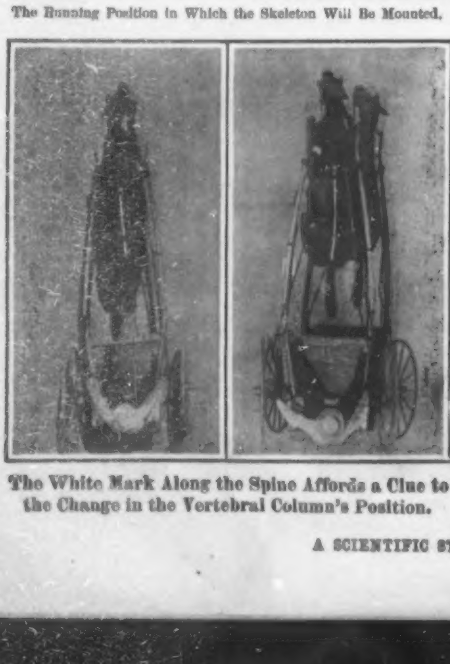
Mr. Chubb and his assistants disinterred the body. Decomposition had left a few traces on the skull; otherwise the bones were in perfect condition. By soaking the bones in water at a temperature of between 90 deg. and 100 deg. for two weeks, and afterward in an immersion of benzine for two months, and by a subsequent exposure to sunlight, all the flesh and grease were removed, leaving the bones polished and snowy white. The one hundred and fifty or more bones are preserved, tabulated, and incased in a series of bureau-like drawers in Mr. Chubb's laboratory. To aid in carrying on his research work, Mr. Chubb has in his laboratory an extensive and varied study collection, at present representing over thirty specimens, ranging from the young two-day colt to the thirty-nine-year-old veteran. The first photograph, showing a glimpse of the experimental stage and the manner of mounting Sysonby, is here seen in one of the accompanying illustrations.



The Bones Will Be Temporarily Tied to Cords and Counterweighted. By Manipulating the Cords the Bones Can Be Moved Until the Correct Position is Obtained.

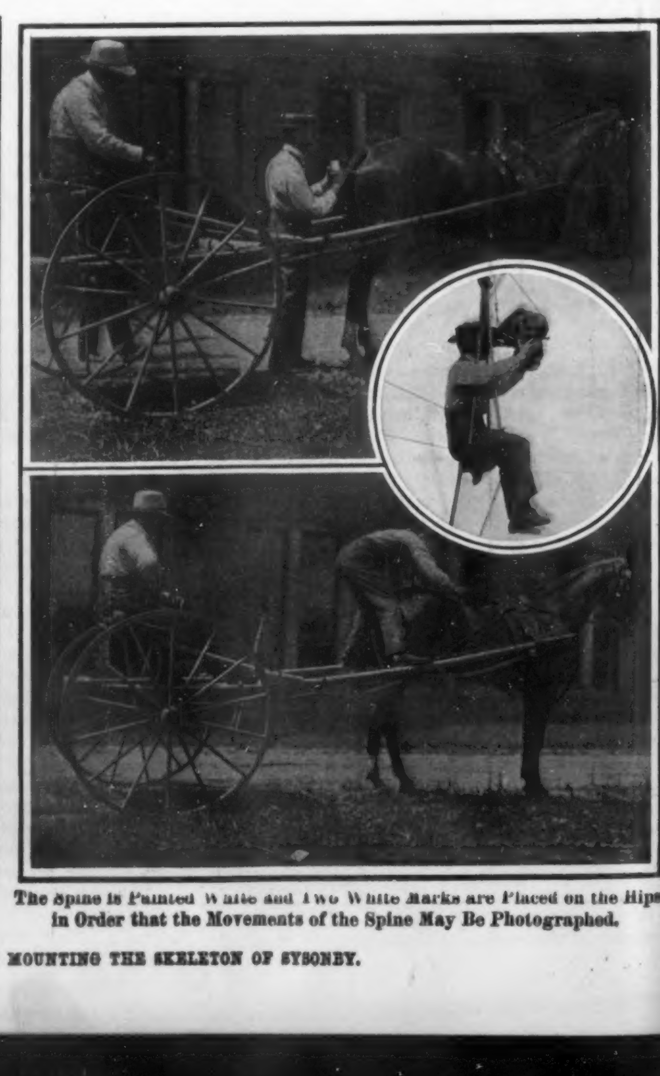
The most novel features used to obtain study material for the mounting are the series of remarkable overhead instantaneous photos now being made by Mr. Chubb. Ordinary side views have been taken before by Muybridge and others, but up to the present no top views have ever been secured. This serial photography is necessary in order to obtain pictures of the spinal column of the horse when moving at full speed. All previous investigators, such as Muybridge and others, did not work along this line. There are no pictures which show this specialized and unknown phase of the fast horse. By special courtesy of Prof. Osborn and Mr. Chubb, the writer was afforded special facilities for witnessing and obtaining some photographs showing the striking and daring manner in which Mr. Chubb, suspended fifty feet or more in the air, in a narrow rope-sling seat, is obtaining some wonderful snap-shots of a trotting horse below. One of these, the first overhead photograph to be published, showing the lateral movement of the spinal column of a running horse, is here reproduced. The horse used is an ex-racer of fine proportions, furnished by a nearby riding academy. In order to follow the movement of the spine, so that it will be perfectly visible on a photographic plate, a white line is painted along the vertebral column; three other spots are painted on the hip and flank, designed to outline the various movements of the pelvis and hip-joints. After these preliminaries, Mr. Chubb climbs into his rope-sling seat, and is hoisted up fifty feet or more. The lens of the instrument is pointed downward, mirrors being employed to reflect the image in a vertical plane, so that the operator keeps the ground glass before his eye exactly as if he were taking a picture in the usual way. In order

The Running Position in Which the Skeleton Will Be Mounted.



The White Mark Along the Spine Affords a Clue to the Change in the Vertebral Column's Position.

The Horse is Photographed from a Height of Fifty Feet.



The Spine is Painted White and Two White Marks are Placed on the Hips, in Order that the Movements of the Spine May Be Photographed.

A SCIENTIFIC STUDY OF THE RACEHORSE, AND ITS USE IN MOUNTING THE SKELETON OF SYSONBY.

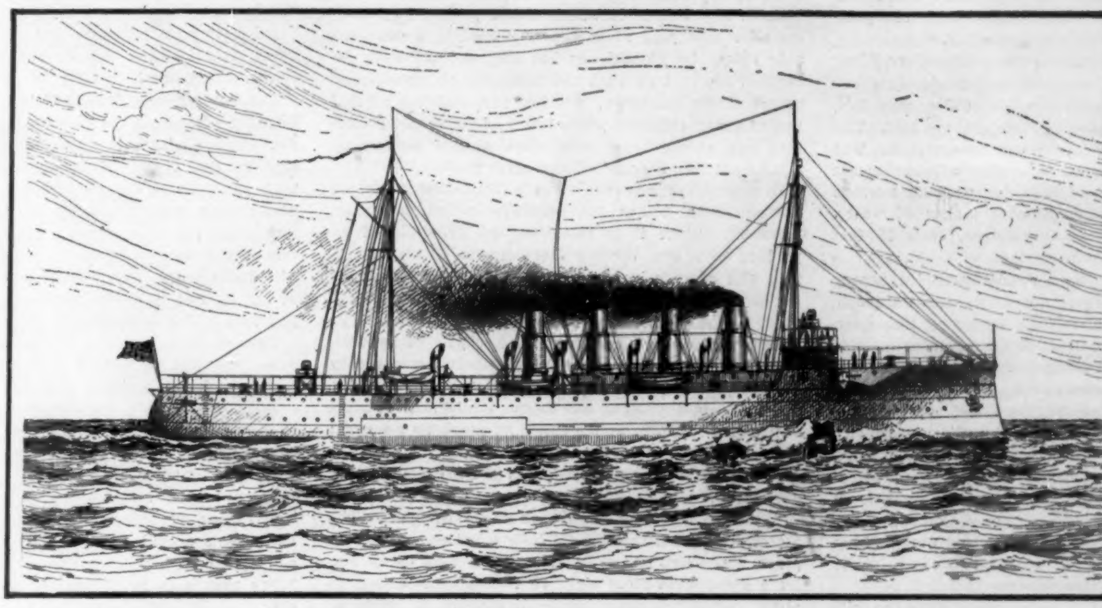
to relieve the strain from the operator and allow free control of the hands, the weight of the box is held by two cords attached to an overhead pulley. The horse and sulky are driven directly beneath, and a sharp focus is obtained on the top of the back. Then comes the actual taking of the picture. The driver sends his steed at full breakneck speed along the roadway, and at the crucial moment, when the animal appears on the reflected mirror of the camera above, the shutter is sprung. The camera used for this high speed is a 4-5 Graflex fitted with a Goertz-Celor lens and focal plane shutter. The exposure is one-thousandth of a second.

In life Sysonby stood 15 hands 3 inches high (that is, 5 feet 3 inches). The length of the mounted skeleton will be a little over 8 feet. One of the accompanying photographs shows the working process and scheme of mounting. After the present series of overhead photos have been studied to advantage, the white mark along the back affording a clue to the approximate change in position of the spine of a moving horse, and after consulting a large number of the best sideview pictures taken of Sysonby in life on the race-track, a characteristic pose will be determined upon. The various bones will be temporarily tied to a series of strings with weights attached, which can be raised or lowered. By manipulating the cords, all the parts can be moved and changed until the final and correct attitude is reached. The approximate running position in which the skeleton will be finished is outlined in the accompanying drawing by Mr. Ignaz Matausch, of the Museum, which drawing however is subject to modification. It will probably take six months or a year, owing to the extensive and painstaking amount of experimental research and labor, before the skeleton is ready for exhibition. When that times comes, it will be a masterpiece from a technical standpoint, illustrating the realistic and up-to-date mounting of the skeleton, as well as fittingly perpetuating the memory of one of the swiftest thoroughbreds ever produced in America. It may be suggested that a chronophotographic camera, mounted on a trolley directly over the moving horse and arranged to travel with him, would more adequately answer Mr. Chubb's purpose. In this manner about forty pictures could be taken every second, and the entire series would record the minutest change in the spine's position for each fleeting moment. The limited means at Mr. Chubb's disposal probably prevent him from carrying out this plan.

Covering for Steam Pipes, etc.—225 parts water, 20 parts potter's clay, 39 parts fossil meal, 7 parts horse or cow hair, 3.5 parts linseed oil, 3.5 parts sifted rye flour, 2.5 parts beet sugar molasses (ultimately, if desired, also 3.5 parts flaxseed meal).

THE NEW UNITED STATES SCOUT CRUISER "SALEM."

The launch on July 27 at the yards of the Fore River Company, Quincy, Mass., of the scout cruiser "Salem" marks the introduction into the U. S. navy of a new type of warship. Her estimated speed, 24 knots, is greater than that of any other cruiser of the navy, and is exceeded only by that of the torpedo boats and destroyers; and while it is a knot less than that of the English scouts now building, the difference in speed is more than compensated for by the ability to maintain the high speed in all conditions of weather, by a coal capacity more than double that of the English scouts, and consequently a greatly increased radius of action.



Length, 420 feet. **Beam,** 46 feet 8 inches. **Draft,** (mean) 16 feet 9¼ inches. **Displacement:** (normal) 3,750 tons; (full load) 4,640 tons. **Horse power,** 16,000. **Speed,** (at trial displacement of 3,750 tons) 24 knots. **Coal,** (maximum) 1,250 tons. **Guns:** Two 5-inch; six 3-inch. **Torpedoes,** two 21-inch.

The Fastest Ship in the United States Navy.

The leading characteristics of the "Salem" are as follows: Length between perpendiculars, 420 feet; length over all, 423 feet 2 inches; breadth, molded, 46 feet 8 inches; draft, fully loaded, 19 feet 1½ inches; depth amidship, molded, 36 feet 5 1-16 inches; displacement, fully loaded, 4,640 tons; displacement on trial, 3,750 tons; draft on trial, 16 feet 9½ inches; total coal capacity, 1,250 tons; coal on trial, 475 tons; maximum speed, average of 4 hours' run, 24 knots; steaming radius at 10 knots per hour, about 6,250 knots; steaming radius at full speed, about 1,875 knots; maximum brake horse-power, main turbine engines estimated, 16,000; indicated horse-power, auxiliaries, 400.

The freeboard of the vessel is greater than that of any other vessel in the navy, being, at the normal draft, 19 feet 8½ inches amidships, 34 feet at the stem, and 21 feet 6 inches at the stern. The high freeboard insures good sea-going qualities, gives great range of stability, and provides a safe and dry vessel under all conditions of weather. On account of the high freeboard it has been possible to provide commodious quarters for the officers and crew, well above the waterline. A forecastle has been provided above the main deck, for about one-quarter of the length, and deck houses have been arranged abaft the forecastle.

Ample subdivision has been made to insure the vessel keeping afloat with no resulting serious change of trim or loss of stability if several of the compartments are pierced. In planning the structural details the greatest care has been exercised to provide a hull which shall combine with lightness the strength and stiffness necessary to successfully withstand the severe shocks which the vessel may be called upon to undergo, and particular attention has been paid to the longitudinal strength of the vessel and to the strength of the watertight bulkheads, that they may be able to withstand the pressure due to the flooding of any compartment and thus avoid endangering the vessel as a whole.

The hull is built of steel throughout; two longitudinal bulkheads are worked continuously throughout the engine and boiler spaces, one on each side, extending from the bottom of the vessel to the main deck, and inclined slightly inboard at the top. In order to avoid any break in the continuity of the strength of the vessel, the upper and lower strakes of these bulkheads extend well beyond the limits of the machinery spaces, forming large brackets gradually tapered off. Between these longitudinal bulkheads, and extending throughout the boiler and engine room, an inner bottom is worked, so that the vessel is well protected from injury in case of grounding.

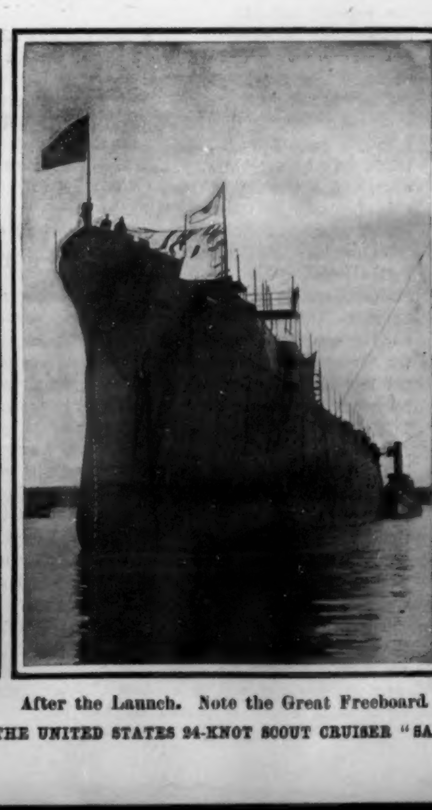
There are five decks, designed as forecastle, main, berth, orlop and platform, respectively, the main and berth decks being continuous from stem to stern. Nickel steel protection of 80 pounds per square foot is worked on the shell plating for the length of the machinery space including the dynamo room, extending from about 3 feet 4 inches below the waterline to about 9 feet 6 inches above, abreast the engine and dynamo rooms, and 6 feet 6 inches above, abreast the boiler rooms. At the forward end of the machinery space and the after end of the dynamo room, partial athwartship bulkheads of 40 pounds nickel steel are fitted, of the same depth as the adjoining side protection. Nickel-steel protection is fitted in wake of the steering engine.

The battery consists of two 5-inch and six 3-inch rapid-fire guns and two 21-inch submerged torpedo tubes.

Two submerged torpedo tubes of the side-loading type with all necessary accessories, including air compressors and accumulators, are installed in the torpedo room forward, one on each side. Four torpedoes will be carried for each tube.

The magazines

On the Ways.



After the Launch. Note the Great Freeboard.

The Lofty Bow.

A NEW TYPE.—THE UNITED STATES 24-KNOT SCOUT CRUISER "SALEM."

have been so arranged that about half the total supply of ammunition will be carried at each end of the vessel, and four ammunition hoists driven by constant-speed electric motors will deliver ammunition to the guns. Battle order and range indicators will be fitted in accordance with the usual naval practice.

The engines are Curtis marine turbines, 120 inches diameter, 7-stage reversible, located in separate compartments, of a combined brake horse-power of 16,000, arranged for outboard turning propellers when going ahead. The steam pressure at throttle valve is 250 pounds, and maximum revolutions at full power about 350 per minute. The necessary auxiliaries and accessories will be provided in accordance with the practice of the Bureau of Steam Engineering.

There are twelve watertube boilers of the Fore River "Express" type, placed in three watertight compartments, with a total grate surface of 693 square feet, and a total heating surface of 37,080 square feet. The working pressure is 275 pounds per square inch. The steaming capacity will be such that all the steam machinery can be run at full power with an average air pressure in the firerooms of 5 inches of water. The "Salem" carries four smokepipes, each 75 feet high above the base.

The arrangement of the quarters provides accommodation for a commanding officer, twelve wardroom officers, five warrant officers, and 340 men. The quarters for the officers are located in the after portion of the vessel, with the usual staterooms, messrooms, etc., as customary in the naval service. The amidship and forward portions of the vessel are given up to the crew, with the usual lavatories, dispensary, sick bay, etc. Quarters for the chief petty officers are provided on the orlop deck forward. For our illustrations and particulars we are indebted to Mr. Francis T. Bowles, President of the Fore River Company, and formerly Chief Constructor of the United States Navy.

Silk from Spiders.

Because of the external resemblance between silk and spiders' webs, it seemed likely that both consist of similar materials. As, however, most spiders' webs are entangled with insects, dust, and other foreign objects, it has so far been impossible to collect a sufficient quantity pure enough for chemical analysis. At the recent French Colonial Exhibition held at Marseilles there was exhibited an interesting silk-like product, which was derived from a big spider living in Madagascar, and which will possibly be manufactured in the near future as a substitute for ordinary silk. In fact, a French Jesuit father, M. Camboué, has installed at Tananarivo a testing plant, in which the spiders are reared in order to be artificially deprived of their webs. Each spider will yield 150 to 600 meters of silk thread at a time, and will die after being emptied five to six times in a month. These webs are of a very beautiful orange-yellow hue.

Prof. E. Fischer, of Berlin, recently succeeded in obtaining a sufficient amount of this substance to carry out a thoroughly scientific analysis, the results of which are given in a paper read before the Berlin Academy of Sciences.

The main component of ordinary silk, viz., a substance called silk fibroin, is a protein which is remarkable for the simple amino-acids that it contains. Spiders' silk was found to be of a quite similar composition, but for the absence of any component soluble in water (glue) and the presence of glutamino-acids. Its beautiful orange color is another distinctive feature.

Because of this remarkable affinity between the two substances, their external resemblance cannot be considered fortuitous. Both substances are known to be produced from the liquid secretion of glands, which on issuing from the animal's body immediately coagulates, acquiring a surprising mechanical strength. This process calls to mind the coagulation of blood. It is true to say that the spinnerets giving off the spider's web, from a morphological point of view, are markedly different from the glands of the silk worm, which supply the material for the silk thread, and which are considered by zoologists as modified salivary glands. The chemical similarity of secretions from organs so dissimilar will be found the more remarkable.

Simple Silvering Process by Dipping.

Roselein has invented a process of silvering without the use of the electric current, and which is specially applicable to small articles of brass or copper, as buttons, screws, hooks, etc. The bath is composed of 22.5 liters of water, 0.906 kilogramme potassium cyanide, and 225 grammes of silver nitrate. Although the cyanide and the nitrate can be dissolved together in water, it is better to dissolve them separately and mix the solutions. Both should be used hot; the best temperature being 50 deg. to 60 deg. C. (122 deg. to 140 deg. F.) The articles to be plated, after having been cleaned, are placed in baskets or attached to wires, and hung in the bath. The silver is deposited almost immediately. If the surface of the articles to be plated is polished, that coating will also be polished; while on matt articles the coating will be matt.

The solution is not to be strengthened from time to time, but used up; and when no more silver is deposited, the bath is to be thrown away. Adding new silver does not improve the work; on the contrary. This is probably because there is a gradual addition of copper or brass, from articles to be plated, to the bath.

A HOME-MADE AIR THERMOMETER.

BY BAKER BROWNELL.

Among the various instruments which have been devised for the measurement of temperature, the air thermometer has the distinction of being the first form of any value. It was invented probably by Galileo about the year 1593, and was used to a considerable extent by physicians; but its readings were deceptive, for at that time the influence of atmospheric pressure was unknown. Galileo invented the alcohol thermometer eighteen years later, and this more accurate and at the same time more simple instrument almost entirely superseded the older form.

In some ways, however, the air thermometer is more efficient than either the mercury or alcohol thermometer. Since it is based on the principle of expansion of a gas, the air thermometer is very sensitive, and offers a large register for a small change in temperature. The reason for this greater susceptibility to heat is evident from the following data. The coefficient of expansion of air is 0.003665, or approximately 1-273 of the volume; the coefficient of mercury is 0.0001815, or 1-5510. Thus, a cubic centimeter of air, upon the application of one degree Centigrade of heat, will expand about twenty times as much as an equal volume of mercury. Besides this, a greater quantity of air than mercury can be conveniently utilized for expanding.

A simple air thermometer can easily be made. The materials needed are a thin, hollow sphere or bulb of glass, about two inches in diameter, having as an outlet a glass stem from eight to twelve inches long, of about one-eighth inch inside diameter. A bottle of considerable weight, about three inches in diameter and from three to five inches high, is necessary. (Any ordinary rather small bottle will do.) This should be half filled with eosin solution or otherwise colored water. A cork stopper for the bottle, having a hole through it large enough to admit the glass stem. The stem must now be partially filled with the eosin solution. This can be done by warming the sphere with the hand, and holding the end of the stem under the surface of the liquid. Some of the expanded air is expelled, and when the hand is removed from the bulb, the eosin solution rises gradually in the tube to fill the vacant sphere caused by the contraction of the cooling air. If temperature changes not far from the normal are to be registered, the eosin should stand finally at somewhat over half way up the tube. It is rather difficult to reach a satisfactory result sometimes, and several trials may be necessary. They are easily repeated, of course, for the liquid already in the tube can be driven out by warming the bulb again.

A HOME-MADE AIR THERMOMETER.

Two grooves, running lengthwise, should be cut into the sides of the stopper to provide for free communication between the air in the bottle and the outside atmosphere. It is essential that the bottle should not be corked air-tight, since this condition would cause a counter pressure of the air in the bottle whenever the air in the bulb is expanded. When the cork stopper has been put in, and the stem of the glass sphere inserted so that the end of the tube is under the surface of the liquid, the air thermometer is complete. A scale of degrees marked on cardboard may be put back of the tube, or the gradations may be scratched on the glass itself, but the readings will be inaccurate, for they will vary with every barometric variation, since the air pressure on the liquid in the bottle fluctuates. In only a much modified and rather complex form can the air thermometer be relied upon for exact measurement.

The delicacy in action of the air thermometer makes it very useful in detecting sudden local changes in temperature. Interesting experiments can be performed with it; for instance, if a piece of filter paper saturated with ether is placed on the bulb, the eosin quickly rises because of the heat absorbed in evaporation. Because of its inconsistencies in readings, however, it is wrongly named as a definite measurer of temperature, for it is really only a thermoscope.

A German Military Airship.

During the course of the last few months decisive alterations have been made in the scope and service of the German Aeronautical Battalion, the merely tactical exercises so far carried out on ordinary free balloons being supplemented by experiments on steerable airships. At the same time the barracks provided for this battalion in the neighborhood of Tegel have been enlarged, and a special corps of engineers organized to design and build a really practicable motor-driven airship for military purposes.

The new airship, according to a recent notice in the Berliner Tageblatt, is designed on similar plans to the Parseval airship, and after having been constructed and tested in perfect secrecy, has performed with satisfactory results a first four hours' trial run. The airship would navigate at a height of 1,500 meters (nearly a mile) with a speed of 45 to 50 kilometers per hour, showing remarkable stability. It is of spindle shape, and is kept horizontal on the escape of gas by two ballonets arranged behind one another, and into which atmospheric air or gas is pumped.

The platform affords accommodation for six persons, and can be armed with guns. Equilibrium is maintained by weights running along bars, which readily compensate any readjustment in weight due to movement or the consumption of ammunition. The experience gained in connection with both the Zeppelin and Parseval airships thus seems to have been utilized to the best advantage.

Dynamos for supplying current to the propellors have been provided, and this airship promises to be a reliable factor for military operations, if its mobility proves to be as perfect as the first trials indicate.

From the Alps to the North Sea in an Airship.

Owing to the special attention which is now being paid to the airship problem on both sides of the ocean, and the recent successful trial trips of French aeronauts, it will be of interest to give some details of a scheme worked out by Count Zeppelin, the well-known German airship constructor.

Zeppelin intends shortly to start on a flight from Friedrichshafen, on the Lake of Constance, to Emden, on the North Sea, and back on the same way, thus twice crossing the whole of Germany.

According to reports in the German daily press, this scheme will be quite practicable from the theoretical point of view, Zeppelin's airship being large enough to store the material required for operation. The distance to be covered on its way would be about 1,600 kilometers (1,000 miles); and supposing the balloon to traverse 60 kilometers (37½ miles) per hour, the whole flight would be completed within 27 hours. When allowing, for the sake of safety, for a journey of forty-eight hours, the flight would still be possible, the amount of benzine carried by the balloon being sufficient for fifty hours.

As regards the practical part of the problem, the maximum journey so far recorded by Zeppelin's airship lasted two hours, while even Lebaudy so far has not completed any flights lasting more than three hours. Some difficulty would be experienced in recharging the balloon if this proved necessary. The direction of the wind would likewise be an important factor to be reckoned with, and even if the wind on starting were specially favorable, it would be the less favorable on the return journey. Finally, there has not so far been a flight without incidents, and these on such a long flight would obviously be the more frequent.

Another factor to be considered is, that the enormous consumption of benzine, as entailed by such extensive flights, would be equivalent to an automatic throwing of ballast, the airship rising ever higher. In order to counteract this, Zeppelin would have to let out gas; and this again would have to be compensated for by throwing out ballast. The resulting alternative rising and falling of the balloon would doubtless put the motor to a severe test. Whether the aeronaut will be able to counteract this phenomenon by dynamical means, keeping his airship at the required height, will have to be ascertained by practice.

Another interesting scheme has been enunciated by Major von Parseval. This aeronaut intends gradually to extend the range of his airship by circular tours of ever-increasing extension, and to begin by a flight round Berlin. This flight will involve a distance of about 60 kilometers (37½ miles) to be traversed, and as this could be done in one and one-half hours, this scheme, while being far more modest than the one above described, would have the undoubted advantage of being considerably more practicable.

Correspondence.

Ignition of Charge in Ordnance and Erosion.

To the Editor of the Scientific American:

My attention is drawn to an article by Henry B. Griffe, of Dubuque, Ia., suggesting that to prevent erosion of the bore in guns, the charge be ignited at base of projectile.

This was done in the needle gun, used in the Franco-German war by the German soldiers. The recoil was so severe that they were speedily condemned.

The method applied to a 12-inch gun would doubtless dismount the piece. Muskets used in the civil war were found to kick in proportion as careless boring placed the point of ignition in advance of base of charge. W. B. Williamson.

Ames, Okla.

Signals for Power Boats.

To the Editor of the Scientific American:

I desire to call your attention to several misstatements in the article published on page 66 of your issue of July 27, entitled "Whistle Signals for Power Boats." The statement that if the pilot of any craft, when signaled to pass to starboard, deems it inexpedient to do so, he can give two blasts and signify his desire to pass to port, is altogether wrong, as can readily be seen from Rule III. of Article 181 (Act of June 7, 1897), which is as follows, and the second paragraph of which should be especially noted:

"Rule III. If, when steam vessels are approaching each other, either vessel fails to understand the course or intention of the other, from any cause, the vessel so in doubt shall immediately signify the same by giving several short and rapid blasts, not less than four, of the steam whistle; and if the vessels shall have approached within half a mile of each other, both shall be immediately slowed to a speed barely sufficient for steerage way until the proper signals are given, answered and understood, or until the vessels shall have passed each other.

"Vessels approaching each other from opposite directions are forbidden to use what has become technically known among pilots as 'cross signals'—that is, answering one whistle with two, and answering two whistles with one. In all cases, under all circumstances, a pilot receiving either of the whistle signals provided in the rules, which for any reason he deems injudicious to comply with, instead of answering it with a cross signal, must at once observe the provisions of this rule."

There are four situations in which two vessels can be found when approaching each other. The first of these is head-on, so that, in the daytime, the masts of the two vessels are practically in line, or that, at night, the red and green lights of each boat are visible from the bow of the other. In this case the vessels must each give one blast of their whistles, thus signifying their intention of passing to the right of each other.

The second situation is where the two boats are to the left of each other as they approach. At night their green or starboard lights only will be visible. In this case they will pass at the left after first each giving two short blasts.

In the third situation the boats are to the right of each other. They will keep to their respective courses, and pass to the right after first giving one blast of their whistles.

In the fourth situation the boats are approaching at an oblique angle. In this case, the vessel which has the other on her own right-hand or starboard side must keep out of the way of the other, and must slacken her speed or stop and reverse if necessary, at the same time indicating her intention by one or two blasts of the whistle as the circumstances may require.

These four situations are the chief ones which can occur, and if the power-boat users will remember the simple rules which govern the control of craft encountering them, there will not be the danger of collision that now frequently occurs. The motor boatmen should remember that the main "rule of the road" is the same on land or sea, namely, "keep to the right"; while when one boat is overtaking another, it is proper for her to give the other warning as to which side she will pass, by blowing one short blast when passing on the right, or two short ones when passing on the left. The overtaken vessel should repeat the signal if there is room for the overtaking boat to pass. If there is not room, she should give four or more sharp blasts, which should cause the overtaking boat to hold back until such time as she receives the signal (one or two short blasts) from the vessel ahead, allowing her to pass.

Motor boatmen should have their attention called to the fact that all open power boats under 10 tons gross are obliged to carry a single combination light showing green and red on the right and left hand sides respectively; to have a suitable whistle or siren; and to carry a 6-inch bell of good tone and quality for use as a fog bell in bad weather. In fog, mist, snow, or heavy rainstorms, a prolonged blast of the whistle must be given at intervals of not more than a minute, while the boat is under way, and when at anchor the bell must be rung rapidly at similar intervals for about five seconds. Pilot.

New York, August 10, 1907.

A New Type of Bullet.

A noticeable feature at the Bisley rifle meet in England this year has been the all-round decided improvement in the scoring. This result is attributable to a new type of bullet, with which experiments are being conducted, the advantages of which are not only an increase in range, but a marked improvement in accuracy, due to the fact that it has a flatter trajectory, and does not require such allowances for wind as are now requisite, since it offers a lesser area of resistance. The present service bullet has a flat conical head, but in the new missile the head is carried to as fine and thin a point as is possible in view of the metal employed in its construction.

The British experiments in this direction were influenced by the tests that have been conducted in European military circles with the Spitzer projectile, which is a light-weight bullet of 150 grains. Military experts who have witnessed the trials therewith were somewhat dubious of its "effective stopping power," considering its light weight. The well-known British ammunition manufacturers, Kynochs Limited, continued private investigations upon the lines of the Spitzer bullet, and as a result of their numerous tests and researches evolved this latest type of projectile, which it is anticipated will revolutionize musketry as much as did the invention of smokeless powder, especially when used in conjunction with the service arm of the British army, the Lee-Enfield rifle, since therewith a point-blank range up to 800 yards is possible. Precisely what this means may be readily grasped, since up to this distance no time need be lost in adjusting sights, it being only necessary to take direct aim and then fire.

The new bullet is similar in construction and weight to that already in use. It is formed of a cupro-nickel envelope containing the softer metal, and weighs 225 grains. The service bullet is similarly built up, measures 1.25 inch in length, is of the same weight, and has a bluff round head. The latest projectile is somewhat longer, due to its being carried to a thin and fine point. With the special ammunition that is used therewith it has, when fired with the Lee-Enfield rifle, a muzzle velocity of 2,400 foot seconds, which is 400 foot seconds in excess of the older type. The results of the trials at Bisley have demonstrated the fact that the resistance which it offers to the wind is fifty per cent of that of the snub-nosed bullet, the wind allowance being as much as 20 deg. less at 1,000 yards, while even at the maximum ranges the difference is equally striking. The scoring at Bisley with this type of bullet has been unparalleled in regard to "highest possibilities," the contrast being emphasized by comparisons under precisely the same conditions with the service bullet; and the level of marksmanship has been raised to an unprecedented degree, especially at the 1,000 and 1,100 yards ranges. It is realized that this remarkable success has been achieved by the combination of the pointed shape with the most suitable weight, a factor which has been resolved after a long series of experimental investigation.

The Largest Cave in the West.

Two gold-prospectors recently discovered in the Santa Susanna Mountains, about fifty miles from Los Angeles, Cal., the largest and most remarkable cave in western America. While looking for indications of gold, they found an opening which they entered. The opening led to a great cavern, consisting of many passages, some of them wide, but most of them narrow and lofty. The passages lead into great halls, some containing an acre, studded with stalagmites and stalactites, in some cases so thickly that it is difficult to get through. The walls of one of these halls are covered with rude drawings, some almost obliterated, but others still clear. The drawings represent incidents of the chase, showing Indians on foot pursuing bear, deer and other animals. One wall-painting shows the bear pursuing the hunter. The work is done with a soft, red stone much used by the Indians for that purpose.

A new gem has been discovered by prospectors in San Benito County, Cal. It is described as a clear, transparent, blue stone with violet tints in the deeper colored portion. It surpasses the sapphire in brilliancy and rivals it in color, though it is not so hard; being about as hard as chrysolite and harder than moonstone or opal. Under heat it turns a bright red but on cooling resumes its normal color. It has been given the name of Benito, from the county in which it was found.

THE LARGEST LOCOMOTIVE EVER CONSTRUCTED.

There has just been completed at the Schenectady Works of the American Locomotive Company a freight locomotive, which, among many other novel and characteristic features, is distinguished by being considerably the largest and most powerful locomotive ever constructed. We give herewith, in addition to the views of the various parts, a photograph of the completed engine, taken as soon as it had been run out from the erecting shop. This truly mammoth locomotive is the first of three which are being built by this company for the Erie Railroad.

To understand the conditions which call for the production of such a monster piece of mechanism, it is necessary to familiarise ourselves with that particular stretch of the Erie Railroad on which the work of the new locomotive will be done. The object of building a part of the motive power in such large units as this is to be found in certain economic principles, by the observance of which it has become possible to haul freight in the United States at a cost per ton very much lower than the rate obtained in other countries.

The three locomotives will be used as helpers on a stretch of up-grade, 8 miles in length, which is encountered by east-bound trains running from Susquehanna to Gulf Summit. The grade is located at the west end of the Delaware division, which is 104 miles in length, and at the east end of the Susquehanna division, which is 140 miles long. The amount of load which a freight locomotive can haul over a given division is determined by the maximum grade on that division; that is to say, as many cars are coupled up behind an engine as it can, unassisted, pull over this grade. The determining maximum grade on each of the two above-mentioned divisions is two-tenths of one per cent; or two-tenths of a foot in 100 feet. At present, the heaviest freight engine of the Erie, weighing 184,000 pounds, can haul a train weighing 3,400 tons from Cornell, at the west end of the Susquehanna division, to Port Jervis, at the east end of the Delaware division, provided it is assisted over the 8-mile stretch of road above referred to containing a one and three-tenths per cent grade. Up to the present time, these freight trains have been assisted over the grade by two and sometimes even three of the heaviest of the Erie helper engines; or if that were not done, it was necessary to cut the train in two. This entailed trouble and delay, and also involved the use of extra engineers, firemen, etc. In order to solve the problem, it was suggested by the American Locomotive Company to concentrate the helping power in one engine of exceptional weight and power, thus placing the whole of the auxiliary power in the hands of a single crew.

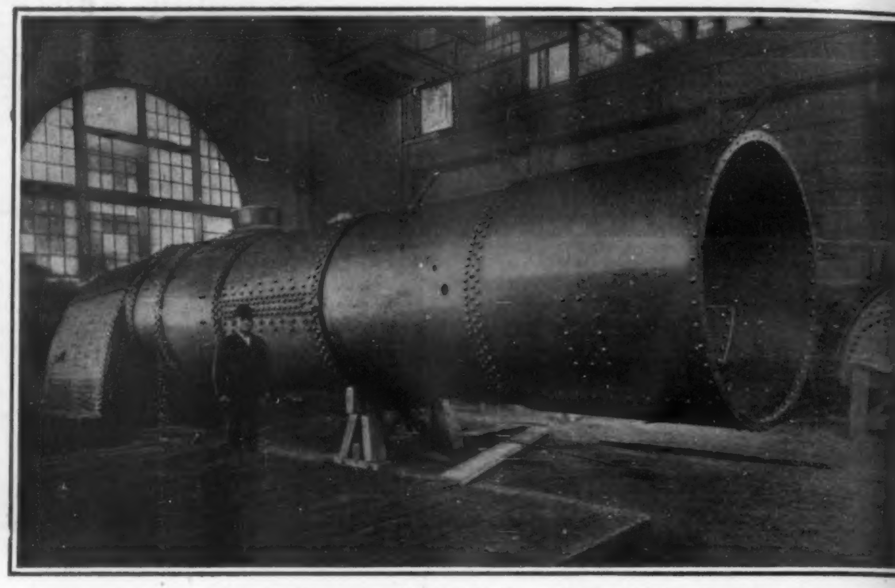
The construction of an engine of the necessary tractive power was rendered possible by making use of the Mallet type of articulated compound locomotive, in which one huge boiler is mounted upon two separate engines, one high-pressure and the other low-pressure, each pair of cylinders being carried upon a separate truck and operating its own set of driving wheels. The first locomotive of this type to be constructed in this country was built by the company for the Baltimore and Ohio mountain service; and in the few years it has been at work, it has given most excellent service, hauling even greater loads than were anticipated, and all the parts functioning satisfactorily. This was followed by a still larger engine for the same class of service, built by the Baldwin Locomotive Company for the Great Northern Company. The third to be built is the huge locomotive which forms the subject of the present article. By a study of the accompanying table showing relative weights and dimensions, it will be seen that the Erie locomotive marks a great advance upon the other two, the total weight of the engine having gone up from 355,000 pounds in the Great Northern to 410,000 pounds in the Erie locomotive, and the tractive effort from 71,600 pounds to 98,000 pounds.

COMPARISON OF THREE MALLET COMPOUNDS.

Road	Baltimore and Ohio.	Great Northern.	Erie.
Builder	American Locomotive Co.	Baldwin.	American Locomotive Co.
Total weight.	334,500 lb.	355,000 lb.	410,000 lb.
Wt. on drivers	334,500 lb.	316,000 lb.	410,000 lb.
Size cylinders.	20 & 32 x 32 in.	21½ & 33 x 32 in.	25 & 39 x 28 in.
Diam. drivers	56 in.	55 in.	51 in.
Tr'ctive effort (compound)	71,500 lb.	71,600 lb.	98,000 lb.
Steam press're	235 lb.	200 lb.	215 lb.
Total wheel base	30 ft. 8 in.	44 ft. 10 in.	39 ft. 2 in.
Driving wheel base, rigid	10 ft.	10 ft.	14 ft. 3 in.
Total heating surface	5,585 sq. ft.	5,658 sq. ft.	5,314 sq. ft.

The high-pressure cylinders are 25 inches, the low-pressure 39 inches diameter, and both have a stroke of 28 inches. The tractive effort of 98,000 pounds will be developed when the engine is working compound; but an intercepting valve is provided, by which

View Looking Into Smokebox, Whose Diameter is 8 Feet.



The Boiler, 8 Ft. Diam., 35 Ft. Long, Weighs 50 Tons. Has 5,314 Sq. Ft. Heating Surface.

Bird's Eye View Showing the Forward Engines.

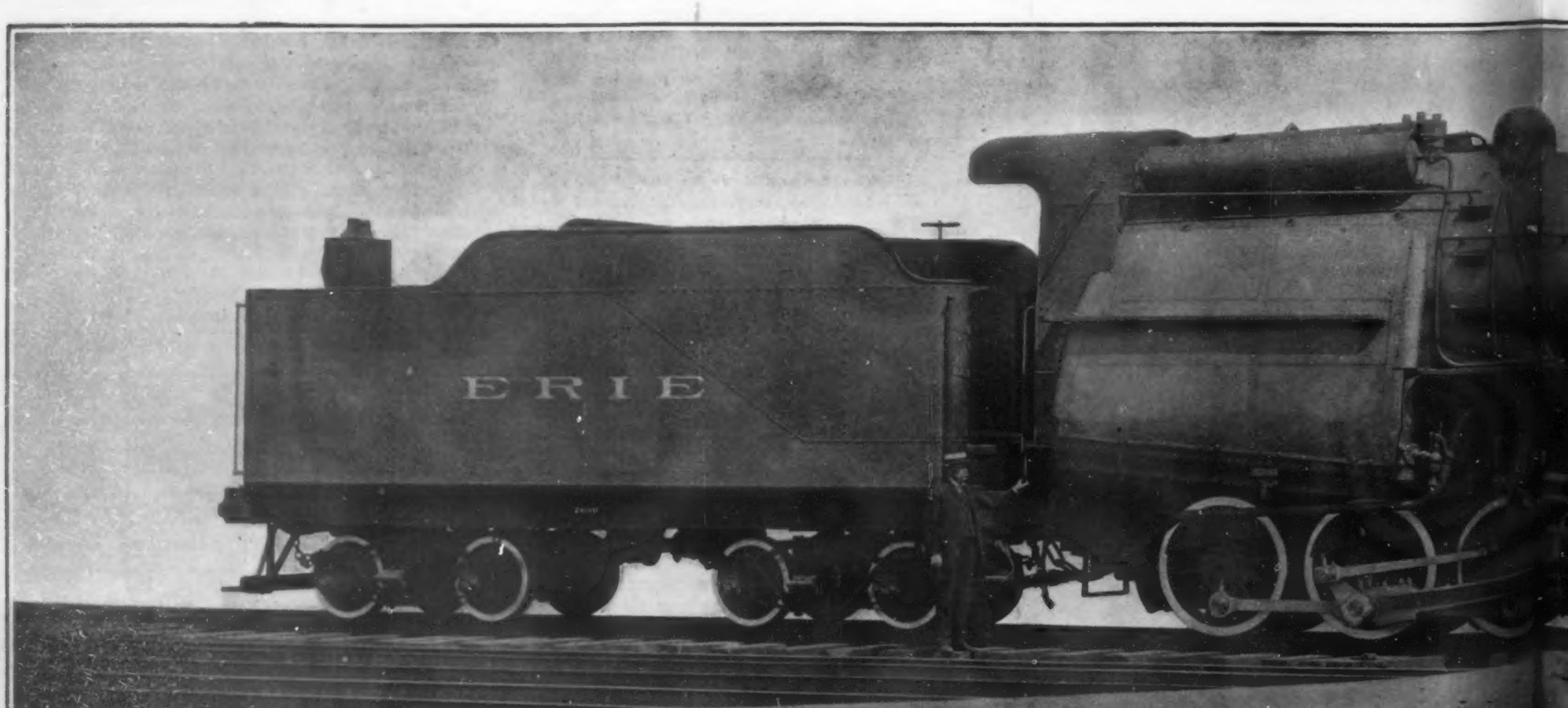
the engineer can turn live steam into the low-pressure cylinders, in which case about 45 per cent of the boiler pressure will be realized in them and the tractive effort proportionally increased, rising to a maximum of about 120,000 pounds. Under these conditions, it is curious to note that the locomotive could haul on the level 250 loaded freight cars, or, say, 10,000 tons of freight, and that the train would be nearly two miles in length. It could pull this load, moreover, at a speed of 8 or 10 miles an hour. If such a train were loaded with wheat, it would represent the product of twenty-six square miles of wheat land.

In a huge locomotive like this, in fact in any locomotive, "the" boiler's "the thing"; and to supply steam to engines of such great capacity, it became necessary to design a locomotive boiler far larger than any in existence. The outside diameter of the largest ring is 98¼ inches; the heaviest ring of the shell being 1 3/16 inches thick. The tubes, of which there are 404, are 21 feet long and 2¼ inches in diameter The firebox, which is of the Wootten type, is 114¼ inches wide by 126⅛ inches long. The weight of the boiler itself, empty, is 100,000 pounds, and the water alone in the boiler weighs over 40,000 pounds. The total heating surface is 5,314 square feet, of which 4,971 is in the tubes and 343 in the firebox, the grate area being 100 square feet.

That the heating surface has not increased in proportion to the other elements of this locomotive, is due to the fact that a 4-foot combustion chamber has been introduced which, of course, reduces the tube heating surface. Were it not for the fact that four feet of the barrel is taken up by the combustion chamber, the total heating surface would be over 6,000 square feet.

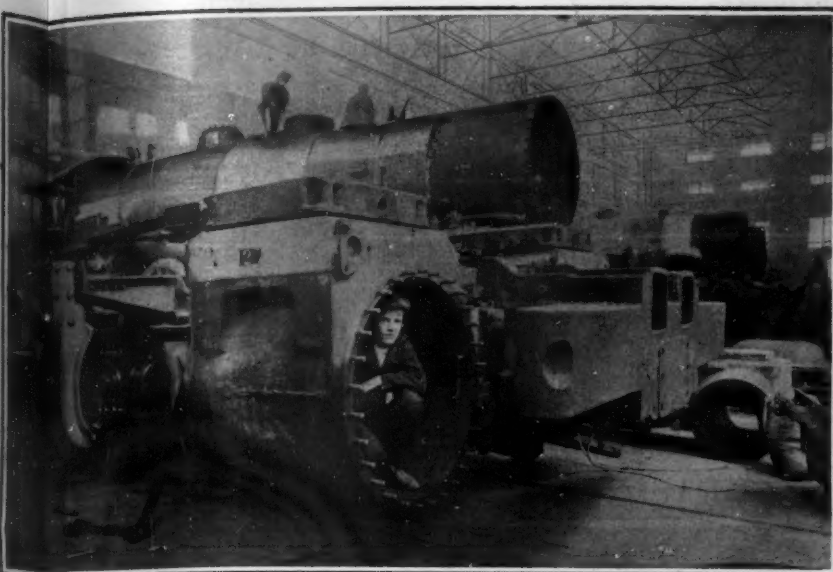
As will be seen from the illustrations, the locomotive is carried upon two sets of eight driving wheels each, all of the eight in each case being coupled, so that the whole of the weight of 210,000 pounds of the engine is available for adhesion. The boiler is mounted rigidly upon the main or after frame of the locomotive, and its weight is borne partly upon this and partly upon the forward radial frame, on the front end of which the low-pressure cylinders are mounted. That part of the weight of the boiler, about 90,000 pounds, which is carried on the forward engines, is supported on a self-adjusting sliding bearing, located between the third and fourth driving wheels, a brass bearing plate being introduced between the boiler bearing-casting and a wrought-iron plate carried on the forward engine frame. There is another sliding support located between the second and third pairs of driving wheels, which is provided with a floating balance device that serves to take some of the load off the main boiler bearing. The forward engine frame is pivoted at its after end to the forward end of the main frame of the engine. When the locomotive enters a curve, the forward engine is free to swing to right or left, as the case may be, the sliding bearing plate and other devices allowing it to do this with comparatively little resistance. As a matter of fact, because of the flexibility of the wheel base, the lateral wrenching effects of this engine upon curves will be less than that of much smaller engines. Moreover, the load being distributed among sixteen wheels, the concentrated wheel load of 51,250 pounds per wheel is considerably less than that of some locomotives of far less total weight. The total weight of the engine is 210,000 pounds, and of the engine and tender 572,800 pounds. The length over all is 80 feet.

The operation of the locomotive is as follows: Steam

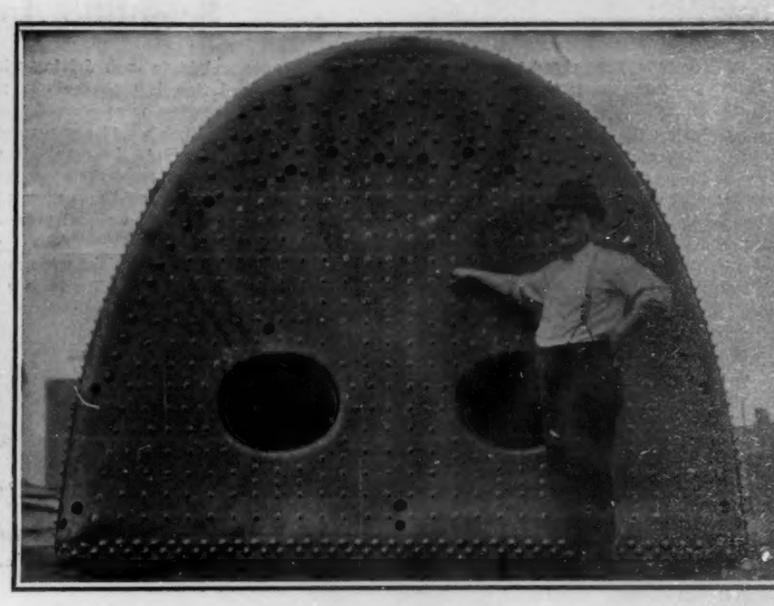


Length, 80 feet. **Weight of Engine,** 205 tons. **Weight of Tender,** 81⅛ tons. **Boiler,** diameter, 8 feet; length, 35½ feet. **Weight of Boiler,** 50 tons. **Heating Surface,** 5,314 square feet. **Steam Pressure** working compound, 49 tons; working simple (live steam in low-pressure cylinders) 60 tons. Working simple, this engine could haul, at

THE LATEST "MOST POWERFUL LOCOMOTIVE IN THE WO



he Diam. (39 In.) of Low-Press. Cylinders Exceeds That of Many Locomotive Boilers.



The Enormous Wootten Firebox, Containing 100 Sq. Ft. of Grate Surface.

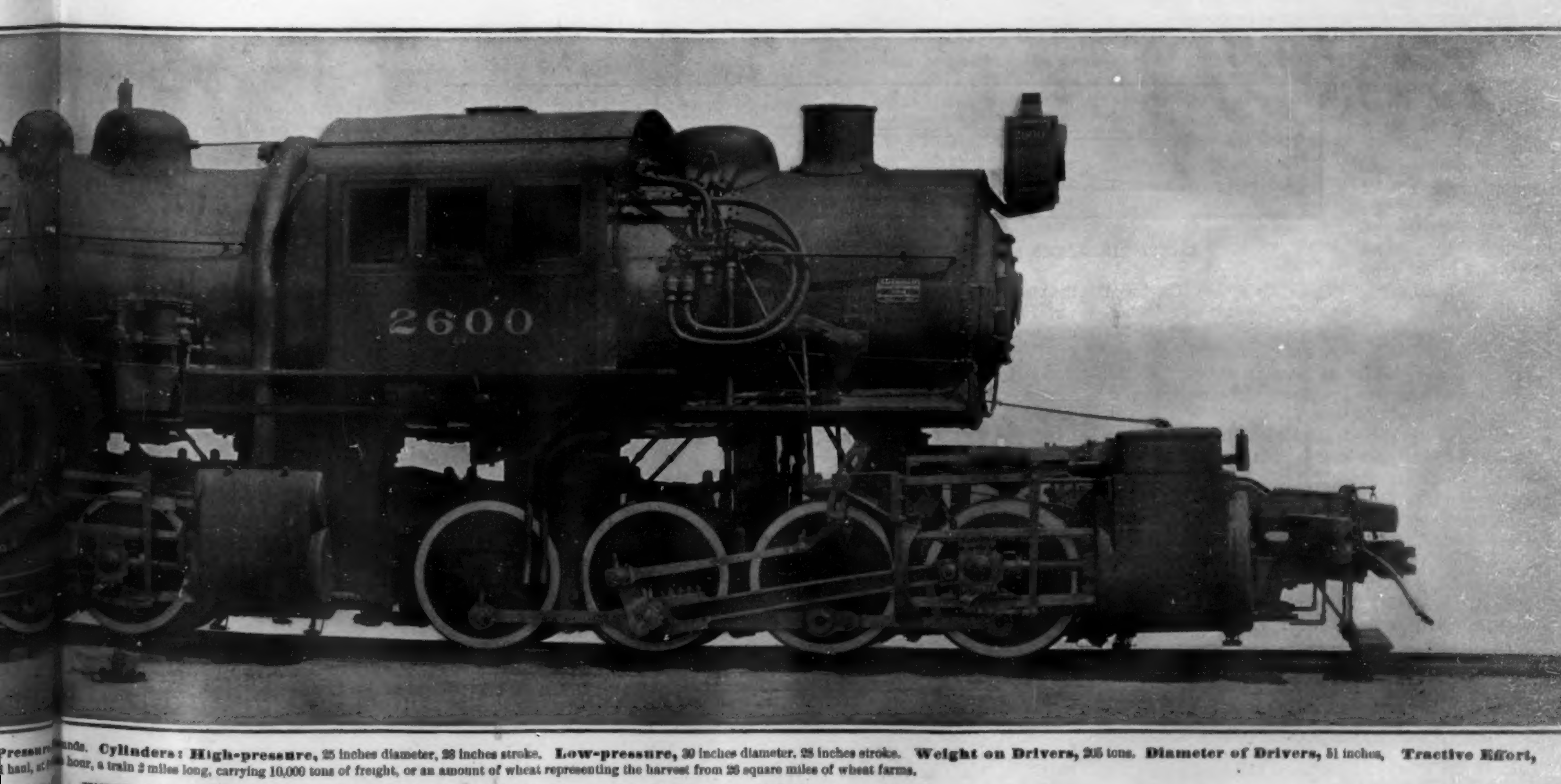
is taken from a dome, placed at the top of the boiler, through a throttle, which is so designed as to act as a steam drier. It passes through steam pipes on each side of the boiler to two high-pressure cylinders, each of which is 25 inches in diameter, with a stroke of 28 inches. The valves are of the piston type operated by a Walschaert gear. From the high-pressure cylinders the steam is led through a pipe placed centrally between the frames, and provided with universal and sliding joints, to a pair of low-pressure cylinders 39 inches in diameter by 28-inch stroke, located far out beyond the front end of the smokebox, as shown in the accompanying illustration. The steam distribution is effected by means of D-valves operated by a Walschaert gear. From the low-pressure cylinders the steam exhausts through the smokebox to the stack. It is an interesting fact that in spite of its great power the operation of this engine is rendered easier than that of an ordinary road engine. This has been made possible by the addition of pneumatic reversing cylinders to the ordinary reversing gear, with provision for positive automatic locking in any desired position.

The front pair of front driving wheels are equalized together on each side, and cross-equalized in front of the forward drivers, making this system equivalent to a single supporting point. The rear engine, on the other hand, is equalized throughout on each side only, without cross-equalization. This forms a complete three-point suspended engine, which is the ideal condition for flexibility and easy action on the track. The excellent record established by the Mallet compound locomotive on the Baltimore and Ohio Railway is a guarantee of the success of this larger venture; and the American Locomotive Company is to be congratulated on having introduced the Mallet type into this country, where the conditions of modern freight service were calling for engines of exceptional weight and power.

Firing Pottery Ovens with Mond Gas.

In order to demonstrate the possibilities and efficiency of Mond producer gas as a medium for firing pottery ovens, an interesting demonstration was carried out at the Royal Victoria Pottery, Shelton, in the center of the pottery industry in Britain. The oven in which the test took place was filled with "biscuit ware," and although at full heat the temperature of the "hovel" of the oven was found to be agreeable, while it was perfectly clean and the atmosphere quite pure, owing to the entire absence of smoke. In regard to its application in this particular instance, the firm adopting the system have evolved a special method, whereby the calorific value of the gas is considerably increased, so that sufficient heat can be obtained for firing any kind of ware, both "biscuit" and "ghost." This end is accomplished by a process of regeneration, the gas and air being superheated before ignition, with the result that a temperature of 1,350 deg. C. can be easily secured, while at the same time the quantity of gas admitted within the oven can be simply controlled. Gas firing, as a result of the trials carried out at this pottery, has proved to be more economical than the systems generally in vogue, both in the cost of the fuel and also in regard to the proportion of breakages, wear and tear of the ovens, and labor. Irregular "baiting" and the imperfect distribution of the heat coincident with coal firing are perfectly overcome. Owing to the success of the experiments at these works, the utilization of producer-gas firing is to be more extensively adopted throughout the pottery district, several supply stations for this purpose now being in course of construction.

Front View Showing Great Size of Low-Pressure Cylinders.



unds. **Cylinders: High-pressure,** 25 inches diameter, 28 inches stroke. **Low-pressure,** 39 inches diameter, 28 inches stroke. **Weight on Drivers,** 205 tons. **Diameter of Drivers,** 51 inches, **Tractive Effort,** hour, a train 2 miles long, carrying 10,000 tons of freight, or an amount of wheat representing the harvest from 26 square miles of wheat farms.

WEIGHT, 286½ TONS. MAXIMUM TRACTIVE EFFORT, 60 TONS.

A LOCOMOTIVE DRIVING-WHEEL RECORDING DEVICE.

In view of the large number of railroad wrecks occurring during the past few months, supposed to be due to defective steel rails, much discussion has been given to the quality of steel used in the rails and the process by which they are produced.

Practically all the steel rails in use in this country are produced by the Bessemer process, the same general outline rail section being used, except from time to time as it has been increased in dimensions and weight to keep pace with the increased weight of the rolling stock.

While it must be admitted that too many rails have to be removed due to manufacturers' defects, at the same time it is hardly reasonable to suppose that all of the trouble due to broken rails is caused directly by these defects; and it is probable that most of the breakages of good-quality sound rails on straight track are caused by loads being placed upon the rails which neither the railroad engineer nor the rail manufacturers ever expected the rail to have to carry, as there are a number of instances of wrecks having occurred on straight stretches of perfectly good track, where the rail was subsequently found to have been broken, though made of good material, while the balance of the roadway was in the best of condition. All explanations heretofore advanced still left the cause shrouded in mystery.

A new thought has just been advanced for these failures on a straight track, and it was brought to light by experiments being conducted to locate the cause of uneven locomotive-tire wear. Mr. D. Patterson, master mechanic of the Colorado & Southern Railroad Company, devised a recording instrument by means of which he was able to transfer to a strip of paper the contour of the tires represented by an irregular line, which varies from a straight datum line an equal amount that the tire varies from a circle; the contour line approaching the datum line if there is a low or flat place in tire, and receding from it if there is a high place.

The recording instrument is called a tiregraph, and the records, tiregrams. By examining and comparing a large number of the latter, it was learned that in nearly every case the defects in the tire bore a fixed relation to the wrist-pin and counter-weights of the driving wheels.

This investigation was then extended to some other roads, and the conditions found to be the same.

The illustration shows the device held in position over the face periphery of the locomotive driving-wheel, having the disk pulley of the paper-winding spool in frictional contact with the outside edge of the wheel, the motion of which slowly draws the recording strip of paper over the platform, on which the record is made by pencils clamped to sliding bars. Another roller, secured to the lower end of a sliding bar, bears against the face of the driving-wheel and vibrates the lateral yoke holding one pencil back and forth, according to the inequalities of the wheel surface. The upper, inner edge of the initial sliding bar is provided with gear teeth, which mesh with the gear of a pivoted segmental wheel, so arranged that the small vibratory motion of the initial slide bar will magnify the movement of the second sliding bar three times greater, and also the pencil carried on this bar to correspond. Thus two records are made on one strip of paper, one of which shows a greater movement of the inequalities than the other, and in an opposite vertical direction. These tiregrams developed that the wear of tires was greatest in the neighborhood of the greatest weight in wheel. Thus, if the crank-pin and its parts were heavier than the counter-weight, the wear would be greater adjacent to the crank-pin, and *vice versa*. Whenever excessive wear was recorded the wheels were reweighed and balanced, and the disparity of weights corrected. In one case a high-speed passenger engine was found to be 230 pounds too light in the counter-balance, and several from 50 pounds to 150 pounds; this unbalanced weight being carried along at from 80 to 100 feet per second, was expected to run smoothly.

The engines tested were of various types—four-cylinder balanced compounds, tandem compounds, outside-connected compounds, simple piston valve and simple slide valve—and equipped with various systems of counter-balances.

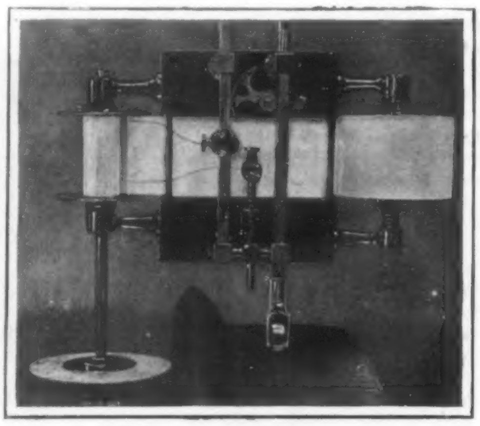
The balanced compounds were equipped with two counter-weights on each main driving wheel, and the wear on tire indicated the location of the weights had been altered, probably in an endeavor to correct the balance.

Most of the other engines were balanced under the master mechanics' methods, and had one counter-balance weight to each driving wheel, and the tiregram showed that if the crank-pin and its parts and the counter-weight were correct according to the formula used, the tires would not wear evenly, but would wear most adjacent to the crank-pin and the middle of the counter-weight, and the space between the weight and the crank-pin would appear as a high place on the tiregram, indicating unequal pressure of the wheel upon the rail.

If the counter-weight were moved toward the crank-pin to one side of its former center line, the high place would be reduced on that side, but would be increased upon the other.

One class of engines was found which produced practically parallel lines on the tiregrams, and they were balanced by the Davis method of using two counter-weights to each driving wheel, the weights placed 120 degrees apart, and forming with the crank-pin center an equilateral triangle.

The upper of the two diagrams shows a more even movement than the lower one. The upper diagram represents the effect of balancing the counter-weights by the Davis method, which shows a fairly even line throughout. The lower diagram shows the common method of arranging the counter-weight opposite the

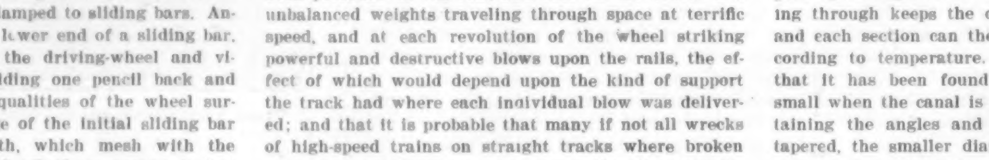


THE RECORDING TIREGRAPH.

crank, and it will be seen that the depression in the record line is very marked opposite the crank-pin. The position of the counter-weights is shown in the small circles at the end of each tiregram.

The interesting conclusion that is drawn from this series of tests is that but one class of counter-balances examined showed practically even tire wear, and hence even pressure on the rail, and that all the others had unbalanced weights traveling through space at terrific speed, and at each revolution of the wheel striking powerful and destructive blows upon the rails, the effect of which would depend upon the kind of support the track had where each individual blow was delivered; and that it is probable that many if not all wrecks of high-speed trains on straight tracks where broken rails were subsequently found, were directly traceable to this condition of the counter-balances, and not to the material in the rails. It is also probable that where wrecks have occurred to trains hauled by electric locomotives without counter-balancing weights in their driving wheels, the initial damage to the rail was caused by a preceding train hauled by a steam locomotive, and that the final giving way of the rail only occurred when called upon to carry the following electric locomotive at high speed. It further indicates that the poor counter-balancing of the driving wheels may be responsible for the failure of a large number of driving-wheel centers, the spokes of which have broken out between the crank-pin hub and the rim, and which the manufacturers have attempted to strengthen by means of webs to connect the spokes to each other.

The above conclusions are only too amply verified by the experience of railroad operators, who have been compelled to replace long stretches of kinked and buckled rails and remove numbers of broken driving-wheel centers, both evidently due to the same cause.



RECORD TIREGRAMS, SHOWING THE EFFECT OF TWO FORMS OF COUNTER-WEIGHTS.

According to a British consular report, a Danish civil engineer has succeeded in producing beer in the form of tablets. These are dissolved in hot water, supplying, when cooled, beer of excellent quality and flavor.

A NEW EGYPTIAN IRRIGATION CANAL.

BY J. B. VAN BRUSSEL.

A very large irrigation scheme is now in process of development in Egypt. The area of land under preparation for irrigation and cultivation is about 125,000 acres; it is bounded on the west by the Nile, and to the eastward is the desert. It is almost midway between Assouan and Edfu; the soil is dry and parched, and is supposed to have received no water for the last 3,000 to 4,000 years. It is, moreover, saline, and for this reason it is necessary to wash the ground for from three to four weeks before any crops can be grown upon it. When first wetted, the ground swells and rises about six inches, afterward subsiding from one foot to two feet. The east bank of the Nile at Kôm-Ombo is too high to allow of the land being irrigated at flood time in the usual manner, and in order to obtain an adequate supply of water for the continual watering of this large tract of land, it was necessary to put down sets of powerful and specially-designed pumps. These pumps, which were supplied by Sulzer Brothers, lift the water through suction mains 6½ feet in diameter, and discharge it into riveted steel rising mains of the same capacity which in their turn deliver the water into a service reservoir. A large steel canal starts from this service reservoir, and delivers the water into distributing earth canals or culverts, from which it flows on to the land. The lift of the pumps is from 16 to 22 yards, and the top of the reservoir wall is 115 yards above sea level at Alexandria. The service reservoir was made of reinforced concrete.

The canal is composed of riveted steel, the plates being ¼ inch thick. It is nearly semi-circular in form, 6½ yards in diameter, with 20-inch straight sides at the top, being therefore nearly 12 feet deep. Its total length is near a mile. It is built up of seven plates round the circumference, the plates being connected together by ½-inch snaphead rivets, of which a total of 650,000 were used. The circumferential seams break joint. External T-iron stiffeners, 5 inches by 3 inches by ⅜ inch, are riveted on at 2 feet 6 inches centers. There is also a top bracing of cross angles, and flat bars bolted on to 3-inch by 2½-inch by ⅜-inch curb angles. To allow for expansion and contraction, the canal was subdivided into seventeen sections, averaging nearly 105 yards each. These were connected together by masonry basins and packed expansion joints. At the end of each section of canal as it entered the masonry basin, a stiffening band 40 inches wide was riveted on, the external rivet heads being countersunk flush. This band is made to slide in and out of the basin on short sections of rail let into the masonry. The joint is kept tight by means of tarred or tallowed rope packing inclosed between two light semi-circular angles placed back to back with bolts passing through them. The weight of the water flowing through keeps the canal floating on the packing, and each section can therefore expand or contract according to temperature. In practice, we understand that it has been found that the movement is very small when the canal is running full. The recess containing the angles and the rope packing is slightly tapered, the smaller diameter being outside, so as to prevent the packing from being blown out by the pressure of the water. For riveting, use was at first made of a compressor plant and steam boiler, together with six long-stroke pneumatic riveting hammers and four calking hammers. Several Englishmen went out to teach the natives and to supervise their work. The native riveters were engaged chiefly from Cairo and Alexandria. Two to three months were spent to make them efficient with pneumatic tools, but the idea had finally to be given up, and the work was finished by hand. The rivets put in by the machines were, on the whole, better than those put in by hand, but the natives could not put in enough rivets per day to make the pneumatic plant pay as against hand work, and the conclusion was come to that the average native was not physically strong enough to work the machines to full advantage. About 15 per cent of the machine rivets had to be cut out. The calking hammers were, however, used right through the contract, and were found to be very useful. The men trained to use them were of the fellaheen class, from villages round Kôm-Ombo, and on the whole they were found to be much better and more reliable than the men from Cairo and Alexandria.

The method of leveling the canal was as follows: During the plating and riveting of the plates, timber cradles were used to keep the bottom level, and props to prevent the sides from dropping out of shape. The cradles were placed about 30 feet apart. The props were placed under the top curb, and shorter ones were fixed under angle cleats bolted to the first longitudinal seam from the top. As each section was completed,

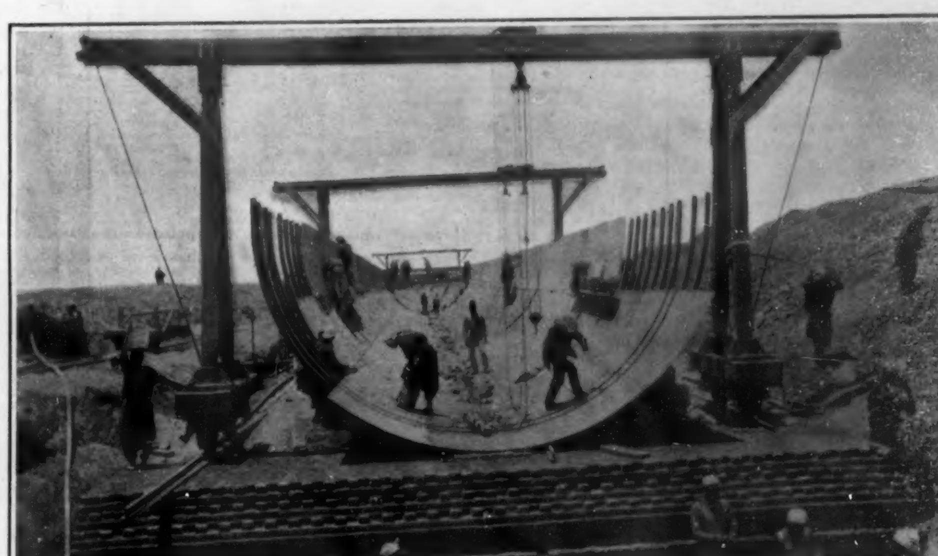
together with the masonry basin by which it was connected to the next section, the canal was adjusted to its proper level by means of Haley jacks, which were placed along each side of the section, and before the jacks were removed earth was banked up on each side of the canal. To insure the banks so formed being solid, the earth was well watered and rammed tight against the steel work. The amount of fall given to the canal was about 2/5 inch per section. One great difficulty experienced in keeping the steel canal level during construction was due to the action of the wind, especially during sandstorms, on the dry sand which formed the foundation. The wind was able to pass under the canal through the spaces where the sand had been removed to allow room for riveting the cross-seams on the bottom plates. This caused the sand to drift, and the wood cradles to sink. A 105-yard section would often sink several inches, on this account, during one night. Another difficulty was due to the unequal expansion of the steel plates, owing to the sun's rays affecting the side of the canal nearest to it more than the other side. In some sections the ends moved out of center as much as 4 inches, sometimes moving one way and sometimes the other. Jacks and props were quite useless to prevent this movement. It is supposed that the explanation of this phenomenon is that the sections could not move, when expanding, in a straight line, and therefore buckled slightly. This movement was not arrested entirely until the canal was banked up with earth, and had the water running through it. The canal was painted with two coats of Siderosthen inside and out. This is a spirit paint with an asphalt or bitumen base. It is applied cold and dries quickly, and it is said to be one of the most satisfactory coatings for this class of work. The total weight of the steel work was 1,250 tons. Seven hundred men were employed, and the work was completed in five months, working day and night without stopping. It was designed to pass 12 cubic meters of water per second at a velocity of 34 inches per second. An inclosed camp was made close to the site for Englishmen; the Arabs being housed some in tents and some in stone houses called *esbahs*. Traveling cranes mounted on rails running astride the canal were used for lifting the plates and fixing them in position. The loose sand foundations caused much trouble, and tools, etc., were constantly being buried and lost. The natives did not like night work, and it was difficult to make the Arab holders-up work at night underneath the canal, on account of the scorpions in the sand. The rising mains are, as already said, 6½ feet in diameter and were about 500 yards long. The plates were ⅜ inch thick, and they were riveted together with ¾-inch band head rivets. The mains were made four plates circumference, the circumferential seams breaking joint. In each main there were two expansion joints. The mains were, like the canal, painted inside and out with two coats of Siderosthen. All the riveting on these mains was done by hand, and the pneumatic plant was only used for calking.

Fellaheen at Work on One of the Sections.

In riveting up the pipes it was found necessary to leave out every sixth plate on the top to allow of sufficient ventilation, so that riveters could work inside; these plates were replaced as the work proceeded. All the inside painting was done at night; owing to the temperature, it could not be done during the day. In order to protect the Arabs from the sun in July and August, three light wooden screens were erected at intervals over the top of each pipe.

The Arabs were fond of drinking the machine oil and anointing their bodies with it. They are not intelligent, and their eyesight, unlike that of the desert Bedouin, is usually very bad. It was not an uncommon sight to see an Arab plater, after several weeks' training, trying to screw a nut on to a drift instead of on a bolt. One of the chief troubles was that the different tribes, etc., did not get on well together, and fought with sticks and knives on the smallest provocation.

Affixing Plates to the Ribs.



Work Progressing on the Seventeenth Section of the Canal.

Inspectors at Work: View Along the Interior of the Canal.

A NEW EGYPTIAN IRRIGATION CANAL.

Mining for Brass in San Francisco.

From the early pioneer days the brass foundry of W. T. Garratt & Co. stood on Fremont Street, San Francisco. When the great fire destroyed the business region of San Francisco in April of last year, the second, third and fourth stories of the foundry were well stocked with goods made of brass, which was melted by the intense heat and ran down into the basement. Much of the metal was recovered easily after the débris of the foundry had been cleared away. Then shovels and screens were used to recover the brass from the soil in the cellar. But a large quantity of brass still remained in the ground, and the manager of the foundry decided to mine for this. There is a small well under the cellar floor, and an electric motor was used to pump the water up to the top of a sluice provided with riffles. The water was then allowed to run back into the well, which, though only a small one, proved sufficient for the purpose. Brass was found in much larger quantity than was expected, and the strange mine has proved highly profitable. For two months it has yielded large returns. The operations have been so successful that they will be extended to the adjoining building, where the casting was carried on. During the half century that the foundry has been in existence the earthen floor has been raised about twelve inches by the gradual accumulation of material, chiefly molten brass that was spilled in making castings. The brass will be washed out from the earth and is expected to yield valuable returns.

Packing for Steam Conductors.—Asbestos 40 p. c., slag wool 20 p. c., wood cellulose 20 p. c., long fibers of hemp rope 20 p. c. Ropes are ground to half stuff, above quantities mixed, ground, poured into plates, saturated with water glass and when dry cut into rings or slabs.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

VENTILATING DEVICE FOR SHOES.—C. R. HENRICKS, Norristown, Pa. This device provides for ventilating the lower parts of shoes. The invention comprises a means for conducting air from one part of the bottom of the foot to another. When the foot is raised in walking, air will be drawn in, and when lowered will be forced out through an eyelet. In wet weather a valve is closed to prevent entrance of moisture.

GARMENT-SUPPORTER.—F. H. NEWTON, Greenville, S. C. The supporter may be used for holding the long gloves now used, and also as a hose supporter. A band is clasped around the arm and two straps project upwardly therefrom and the glove drawn up over the buttons. Clasps are turned down to engage with the glove and secure the same upon their respective buttons.

Electrical Devices.

ELECTRODE FOR SECONDARY BATTERIES.—L. CHRONIK, New York, N. Y. The object in this case is to provide an electrode or battery plate for secondary or storage batteries arranged to provide a very large exposed surface for the electrolyte and to readily retain the absorptive material. It relates to batteries of the Planté type having electrodes made of lead and the like, and an electrolytic fluid, such as diluted sulfuric acid.

TROLLEY-POLE ATTACHMENT. — P. F. DUBOSE, New York, N. Y. A purpose in this invention is to provide a very effective pole attachment, in which the guide fingers located at the sides of the trolley wheel and extending above the same will automatically pass all manner of overhead obstructions, and wherein said fingers may be purposely drawn from the wire at any time found necessary.

ELECTRIC SIGNAL.—M. A. EWING and J. H. EWING, Gallatin, Texas. The improvement pertains more particularly to an electric apparatus suitable for block signals, and in all relations where the movement of rolling stock or the like is controlled by, or exerts control over, appropriate alarm mechanism. Also, to means for producing an alarm upon a movable member of rolling stock, such as a locomotive, and independently of this alarm for producing another alarm at a station or other predetermined point.

Of Interest to Farmers.

LOW-LIFT PLOW.—D. HALLORAN, Paris Station, Ontario, Canada. The object of this inventor is to provide means adapted to enable the plow to make a short turn; to permit it to be readily adjusted to regulate the depth of cut, to regulate the width of cut of the furrow; to enable it to be readily lifted out of the ground or placed therein; to enable the rear furrow wheel to be locked in position or to run at will; and to provide means whereby the wheel and pivotal connection of the plow with the main frame may be operated by the main lever.

GATE-HINGE.—O. REPPERT, J. F. FRUCHTE, and F. L. LITTERER, Decatur, Ind. The purpose of the invention is to provide details of construction for a gate hinge, especially well adapted as an adjunct for a farm gate, and that will release and permit the lateral opening movement of such a gate when the hinge is rocked on its support in either direction.

Of General Interest.

CONSTRUCTION OF BRICK PAVEMENTS. —J. M. PERKINS, Memphis, Tenn. The aim of this invention is to provide an especially hard filler for the joints between the bricks when laid in street pavements, which filler is hard and smooth, is applied in a liquid or semi-liquid state, and will tend to render a pavement less noisy than when laid with the usual fillers, since the tendency of the proposed filler is to deaden sound.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

PRESBREY'S INFORMATION GUIDE FOR TRANSATLANTIC TRAVELERS. Fifth Edition. New York: Frank Presbrey Company. 1907. Pp. 20. Maps and plates. Price, 25 cents.

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